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Aerial Assessment of Red Spruce & Balsam Fir Condition

in the

Adirondack Region of New York,
the Green Mountains of Vermont,
the White Mountains of New Hampshire,
and the Mountains of Western Maine

1985-1986

AERIAL ASSESSMENT *of* RED SPRUCE & BALSAM FIR CONDITION

in

The ADIRONDACK REGION *of* NEW YORK,
The GREEN MOUNTAINS *of* VERMONT
The WHITE MOUNTAINS *of* NEW HAMPSHIRE,
and The MOUNTAINS *of* WESTERN MAINE
1985-1986

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SUMMARY

In 1985, a project was initiated to map the extent and severity of standing dead red spruce and balsam fir in the Adirondack Region of New York, the Green Mountains of Vermont, the White Mountains of New Hampshire, and the mountains of western Maine. Approximately 4.6 million acres were aerially photographed, excluding the vast areas of low elevation spruce-fir forests, much of which has been affected by past repeated spruce budworm defoliation.

The photography was stratified by spruce-fir cover type and mortality class, based on proportion of standing dead (light—less than 10 percent, moderate—10 to 30 percent, and heavy—greater than 30 percent). The information was processed and overlaid with elevation data on a Geographic Information System. Over 700,000 acres of red spruce and balsam fir were identified within the photographed area (about 220,000 acres in New York, 52,000 acres in Vermont, 200,000 acres in New Hampshire, and 243,000 acres in western Maine).

Almost two-thirds of the spruce-fir area was typed as spruce-fir slope, nearly one-third as mixedwood, and a small component as spruce-fir swamp or balsam fir type. Half of the area was classified as having a low proportion of standing dead, with the other half of the area equally divided between the moderate and heavy classes. The distribution of cover types and standing dead varied somewhat among the states. In general, at the higher elevations, there was a greater proportion of each cover type with a high proportion of standing dead. The survey results reflect a point-in-time evaluation of standing dead trees, some of which may have been dead for over 10 years. The relationships between spruce-fir forest conditions and elevation are discussed, and distribution maps of the forest conditions within the survey area are presented. ❧

INTRODUCTION

Spruce-fir forests are an important resource in the northeastern United States, encompassing over 10 million acres. The spruce-fir forest type occurs in northern New York, Vermont, New Hampshire, and Maine within the Adirondack-New England Highlands Region. The spruce-fir type is comprised primarily of red spruce (*Picea rubens* Sarg.) and balsam fir (*Abies balsamea* (L.) Mill.). Depending on successional stages and site conditions, various combinations of associated hardwoods and softwoods are found within the spruce-fir type, which occupies the shallow soils on sites in flat terrain and on steeper mountain slopes (Eyre 1980). The soils usually are acid, associated with abundant rainfall, and cool climate (Frank and Bjorkbom 1973). On deeper soils, spruce and fir are found in association with hardwoods (Blum et al. 1983).

Red spruce and balsam fir are used for lumber and pulpwood and many stands have been cut several times, resulting in degradation of the residual forest (Chittenden 1905; Oosting and Reed 1944; Westveld 1931). Also, fires followed logging activities in the last century (Chittenden 1905). As a result, red spruce, over 200 years old, are found in only a few remote areas (Oosting and Billings 1951). Since the age of the resource varies, stand conditions also vary from healthy, regenerating stands to stagnant, mature stands, where insect pests and pathogens are common.

There are various biotic and abiotic factors that have historically caused mortality and affected the growth and condition of red spruce and balsam fir (Weiss and Millers 1988). Several major spruce beetle (*Dendroctonus rufipennis* (Kirby)) outbreaks have caused mortality in mature red spruce stands (Hopkins 1901). Souto and McCreery (1988) described the effects of a recent outbreak in the Adirondack Region of New York. Spruce budworm (*Choristoneura fumiferana* (Clemens)) has caused large areas of defoliation, with the most recent outbreak occurring from 1970 to the early 1980's in

Maine, northern New Hampshire, and northeastern Vermont (Kettela 1983). Eastern Dwarf Mistletoe (*Arceuthobium pusillum* (Peck)) and stem and root rot organisms, such as *Armillaria* spp., cause crown dieback and tree mortality (Carey et al. 1984; Hawksworth and Shigo 1980; Rizzo and Harrington 1988).

Abiotic factors affecting the condition of spruce-fir forests include: extreme temperatures (Kozlowski et al. 1991; DeHayes et al. 1990); drought and desiccation events (Curry and Church 1952); and wind and rime ice at the higher elevations (Graves 1899; Harrington 1986; Worrall and Harrington 1988). Windthrow and stem breakage is extensive in upper elevation spruce-fir forests since trees growing on these sites have shallow root systems, they are growing in generally thin soil, and root and butt rot is prevalent (Blum et al. 1983). Large areas of balsam fir mortality occur in high elevations from repeated exposure to wind and snow resulting in the phenomenon referred to as fir waves (Sprugel 1976). Hurricanes have periodically destroyed large stands of spruce and fir (Natti 1979).

In the early 1980's, new concerns were raised over the condition of spruce-fir forests in the eastern United States (Johnson and Siccama 1983). The Cooperative Survey of Red Spruce and Balsam Fir Decline and Mortality in New York, Vermont, and New Hampshire was conducted in 1984. The results of this survey, based on randomly selected survey blocks, and other surveys, indicated significant areas of dead red spruce and balsam fir occurred in New York, Vermont, and New Hampshire, and also in western Massachusetts and West Virginia (Weiss et al. 1985; Mielke et al. 1986; Miller-Weeks and Cooke 1989). In addition, an overall growth decline of red spruce was observed in the northeastern United States (Hornbeck and Smith 1985; Van Deusen et al. 1991). The extent and severity of the mortality and growth decline may not be completely explained by historical causes. Recent hypotheses of contributing causes include the effect of long-term climate change and exposure to chronic or acute episodes of air pollution (Cook and Johnson 1989; Johnson and Siccama 1983). Stand aging and winter injury also play a role (DeHayes et al. 1990). It also is suggested that pollutant deposition may indirectly affect trees by altering soil chemistry and inducing nutrient deficiencies (Shortle and Smith 1988).

PROJECT OBJECTIVES

In 1985, as a follow-up to the 1984 Cooperative Survey of Red Spruce and Balsam Fir Decline and Mortality, a project was initiated to determine the extent and condition of red spruce and balsam fir in the mountainous areas of the northeastern United States. The objectives were to map the condition of red spruce and balsam fir, based on the proportion of standing dead trees, and determine the acreage in each cover type and mortality class by elevation. The survey objectives and methods were similar to those of the Evaluation of Spruce and Fir Mortality conducted in the southern Appalachian Mountains in 1988 (Dull et al. 1988). The results give an indication of the cumulative mortality in recent years since dead trees, especially red spruce, can, in some cases, stand for over 10 years. This report provides baseline data for comparison with subsequent surveys to determine if there are any significant changes in the extent and intensity of the amount of standing dead red spruce and balsam fir in the mountainous areas of the northeast. ❧

METHODS

Approximately 4.6 million acres were aerially photographed in northern New England and New York, 1.1 million in New York, 1.4 million in Vermont, 1.4 million in New Hampshire, and 0.7 million in Maine (Figure 1). The areas photographed were mostly in the mountainous regions of the states. Large areas of spruce-fir forest which occur at the lower elevations in the flat terrain, especially in northern and eastern Maine, were not included in this survey, due to the impact of repeated spruce budworm attack in many locations.

In late summer of 1985, complete stereo photo coverage was obtained of the White Mountain National Forest in New Hampshire, the Green Mountain National Forest in Vermont, and most of the spruce-fir forests in the Adirondack Region of New York at a scale of 1:24,000. In 1986, the western mountains of Maine were photographed at a scale of 1:20,000, along with additional areas in northern New Hampshire and New York. These areas were predominately spruce-fir forests with an abundance of standing dead trees identified from aerial reconnaissance.

The USDA Forest Service, Methods Application Group, Fort Collins, Colorado, and Forest Pest Management staff in Atlanta, Georgia, acquired the aerial photographs utilizing a 9-in format camera with a Wratten 12 haze filter. Color infrared film (CIR) was used since it provides good contrast between conifers and hardwoods, and between healthy trees, dead trees, and trees with foliar discoloration or crown dieback. The film transparencies were laminated and the effective area on each photograph to be interpreted was delineated so that overlapping coverage from adjacent photos was excluded.

Areas of a minimum size of 20 acres were stratified, based on cover type and proportion of standing dead, using zoom stereoscopes. The classification scheme was derived from photo interpretation guidelines developed for the

1984 Cooperative Survey of Red Spruce and Balsam Fir Decline and Mortality in the Northeast (Ciesla 1984 and Weiss et al. 1985).

The following forest cover types containing spruce and fir, which were used for this survey, were based in part on similar cover types defined for the Adirondacks region in New York (Braun 1950):

SPRUCE-FIR SWAMP
Contains greater-than-50-percent red and black spruce and fir in the overstory. Found on poorly drained sites with peat soils at various elevations in association with larch, eastern white pine, northern white cedar, and sometimes yellow birch and hemlock.

MIXEDWOOD
Contains greater-than-25-percent, but less-than-50-percent, spruce and fir in the overstory. Characteristically occupies well-drained sites at medium elevations in association with various hardwood species, such as birch, maple, beech, white ash, and sometimes eastern white pine and hemlock.

SPRUCE-FIR SLOPE
Contains greater-than-50-percent spruce and fir in the overstory, with red spruce the dominant species. Includes areas commonly referred to as spruce-fir flat. In general, sites are moderate, to well-drained. At medium-to-high elevations, balsam fir and white birch are common.

BALSAM FIR
Contains greater-than-90-percent fir in the overstory, in association with spruce and white birch on rocky soils at the higher elevations. Extensive balsam fir stands are also found at the lower elevations in more northerly latitudes. (Within this cover type, areas with prominent fir waves were identified).

NON SPRUCE-FIR AREAS
Areas with predominantly other conifers, hardwoods, krummholtz, nonforested vegetation, rock outcrops, or water and residential areas.

As the areas of cover type were delineated on the aerial photography, they were stratified further into three mortality classes based on percent of standing dead trees.

LIGHT: less than 10 percent.
MODERATE: 11 to 30 percent.
HEAVY: greater than 30 percent.

The separation of cover types and mortality classification was limited by distinguishable color and crown characteristics on the color infrared photography. A systematic ground-truth check of the photo interpretation was not conducted; however, quality control was ensured using standard remote sensing lab practices, along with intensive training and standardization, ground-truth verification of problem areas, and interpreter cross-checking.

The information acquired from the aerial photography was transferred to USGS 7.5-min topographic and orthophoto quadrangles using a stereo zoom transferscope. The cover type and mortality areas, and associated labels, were digitized for each 7.5-min quadrangle within the survey area. The elevation contours of 2,600 ft, 3,600 ft, and 4,600 ft also were entered as a separate data layer. Data entry and processing were accomplished by the Forest Conditions Mapping and Analysis Unit within Forest Health Protection using a color graphics terminal linked to the University of Maine mainframe computer to provide access to the Maine Geographic Information System (MeGIS) software. This polygon-based software package was developed by the Resource Information Management & Spatial Analysis Laboratory, College of Forest Resources, University of Maine, Orono.

The cover type, mortality (standing dead), and elevation data layers were used to produce

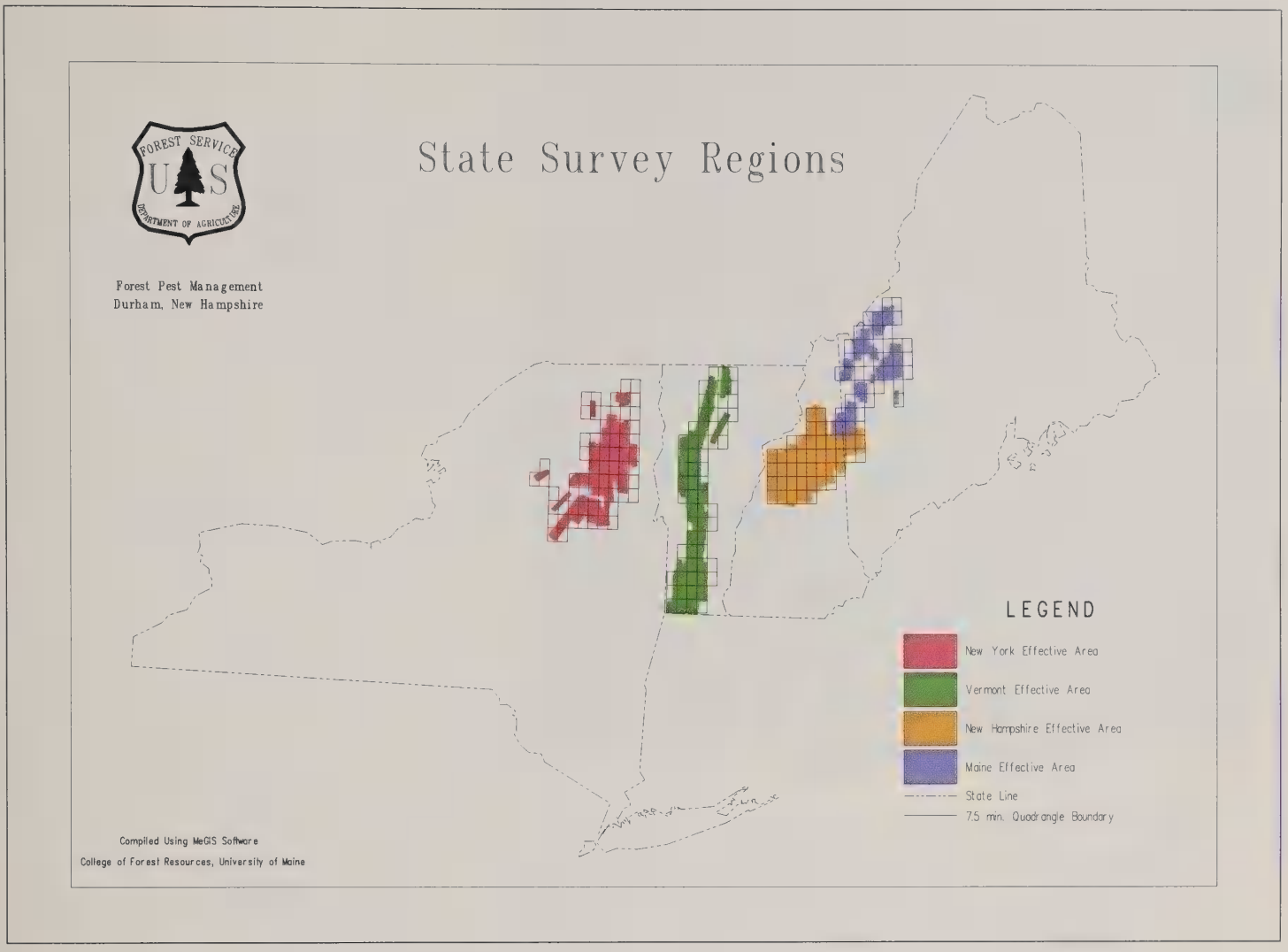


FIGURE 1.
State survey regions.

acreage tables and maps. The area within each spruce-fir cover type and standing dead class was summarized for each state. The data were then overlaid with the elevation information and summarized by zone (less than 2600 ft, 2600 to 3600 ft, 3600 to 4600 ft, and over 4600 ft). Maps, which were produced on a drum plotter at various scales, show the distribution of spruce-fir forest conditions. Within each state, separate mapping units were created by using major roads or trails as divider lines. Polygons which crossed divider lines were not sectioned, but, rather were included in their entirety within the unit that contained the greater portion of the polygon. An overview of the results of the survey is presented, as well as a separate discussion on the condition of the spruce-fir forests within the survey area in each state. ❧

OVERVIEW *of* RESULTS

There were 713,895 acres of spruce-fir forest identified within the survey area, with 219,774 acres in the Adirondack Region of New York, 51,695 acres in the Green Mountains of Vermont, 199,384 acres in the White Mountains of New Hampshire, and 243,042 acres in the mountains of western Maine. Not all of the spruce-fir forests in each state were photographed. This survey focused on the mountainous areas where spruce-fir forests occur and, in addition, includes the lower elevation spruce-fir forests which surround the mountains.

COVER TYPE

The largest cover type was spruce-fir slope, 62 percent of the total spruce-fir cover type acreage (Table 1). Mixedwood was 31 percent of the total. Spruce-fir swamp and balsam fir were minor components in all the states. Spruce-fir slope was the predominant type in Maine, New Hampshire, and New York, with the highest proportion in Maine and New Hampshire (Figure 2). The predominant type in Vermont was mixed wood. The smaller proportion of spruce-fir slope in New York, compared to Maine and New Hampshire, was offset by higher proportions of mixedwood and spruce-fir swamp. New York had over 2.5 times as much spruce-fir swamp acreage as all the other states combined as well as the greatest acreage of mixedwood. The highest acreages of balsam fir were in New Hampshire and New York. This is due to greater land area at higher elevations in those states.

Occurrence of the spruce-fir cover types varied depending on elevation and latitude. Figure 3 illustrates the distribution of spruce-fir

cover types, with respect to elevation, in each of the states. Fifty-four percent of the area mapped was below 2,600 ft, with less than 10 percent above 3,600 ft (Table 2). The acreage below 2,600 ft in New York and Maine alone made up over one-third of the total spruce-fir forest within the survey area. Although the total area of spruce-fir forest within each state varies, the relationship of cover type to elevation remains fairly constant, with spruce-fir swamp and mixedwood predominately at the lower elevations, balsam fir at the higher elevations, and spruce-fir slope found within all elevations. Because of differences in latitude, distribution by elevation of spruce-fir forests in the northeast contrasts with that of spruce-fir forests in the southern Appalachian Mountains where only approximately 7 percent is below 4,600 ft (Dull et al. 1988).

MORTALITY (STANDING DEAD)

The area in each cover type and mortality class based on proportion of standing dead trees within each state is shown in Table 1. The classes, used to report relative health conditions, reflect a point-in-time evaluation of standing dead trees and do not imply a change in the rate of mortality or a suggestion of what is normal. It is uncertain how long dead trees remain standing, however, red spruce persists longer than balsam fir. In high elevation, noncommercial stands, mortality rates may be higher than in low elevation managed stands. Statements about the normality of forest health conditions from point-in-time estimates using aerial photos are difficult without considering stand age and density, individual site characteristics, and land use history.

Forty-five percent of the mapped acreage of all states combined was in the light mortality class, with the rest of the area equally divided between the moderate and heavy classes (Figure 4). The amount of standing dead acreage varied among states (Figure 5). New York had the most moderate or heavy mortality. In Vermont, New Hampshire, and Maine, 46 per-

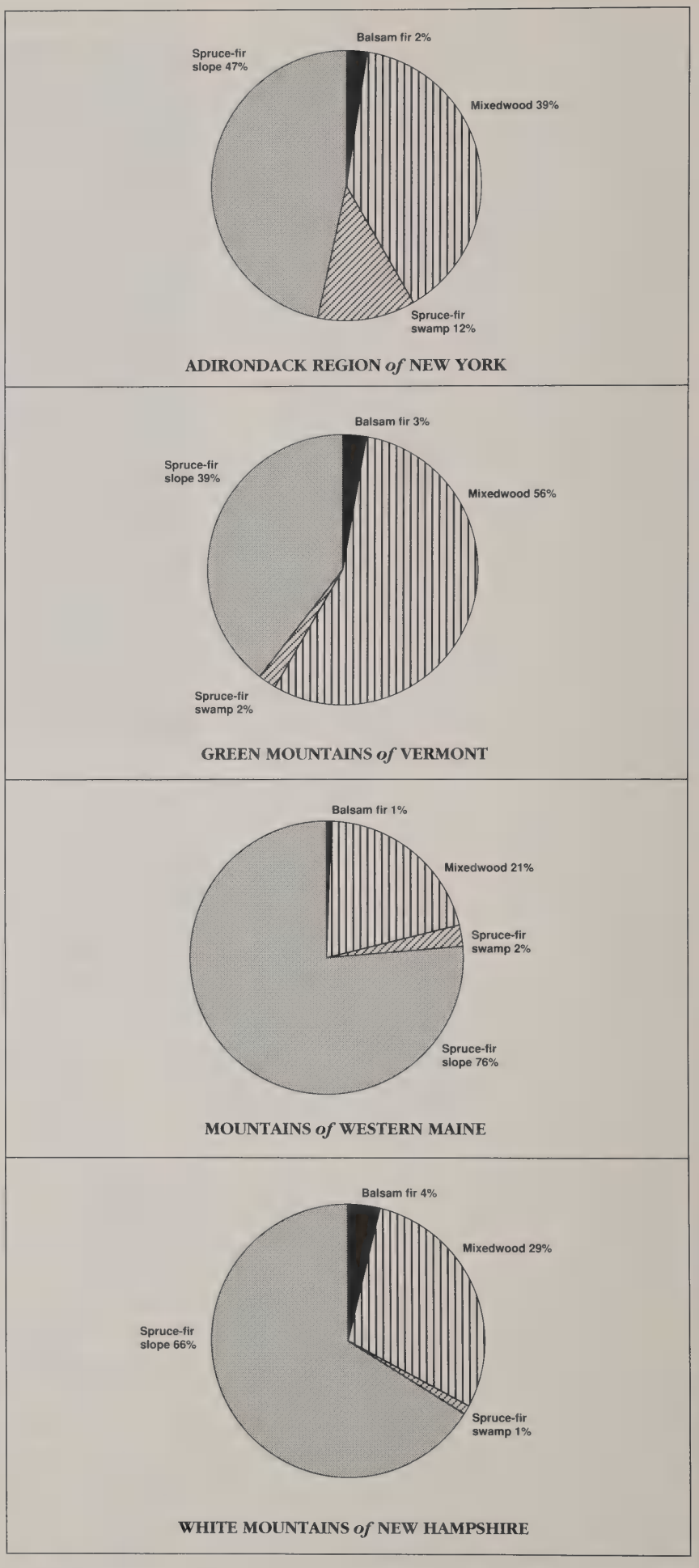


FIGURE 2.
Distribution of spruce-fir cover types within the photographed area.

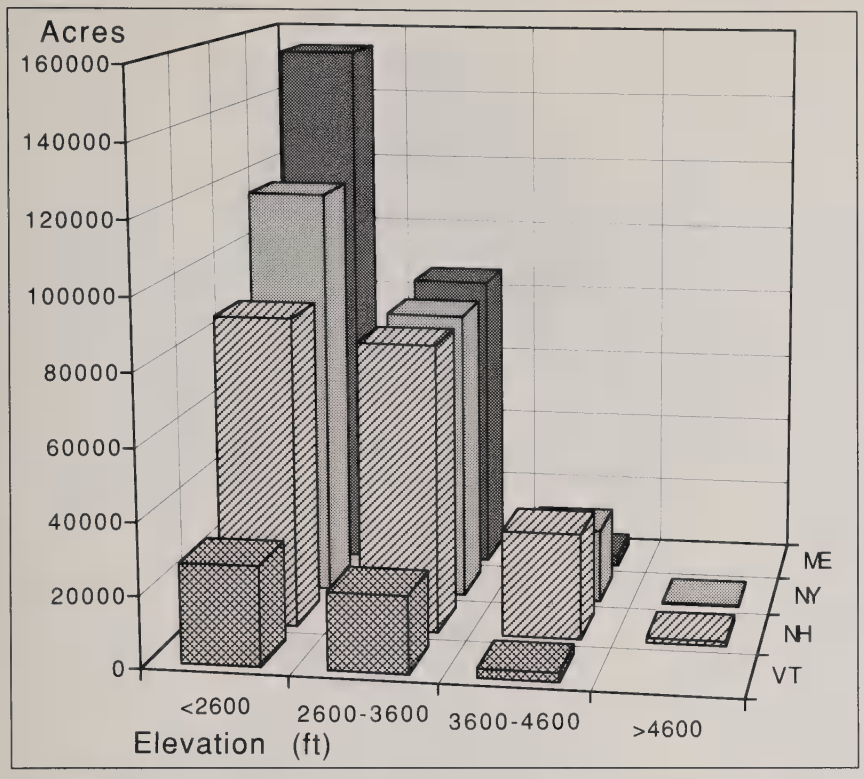


FIGURE 3.
Distribution of spruce-fir cover type by elevation within the survey area in each state.

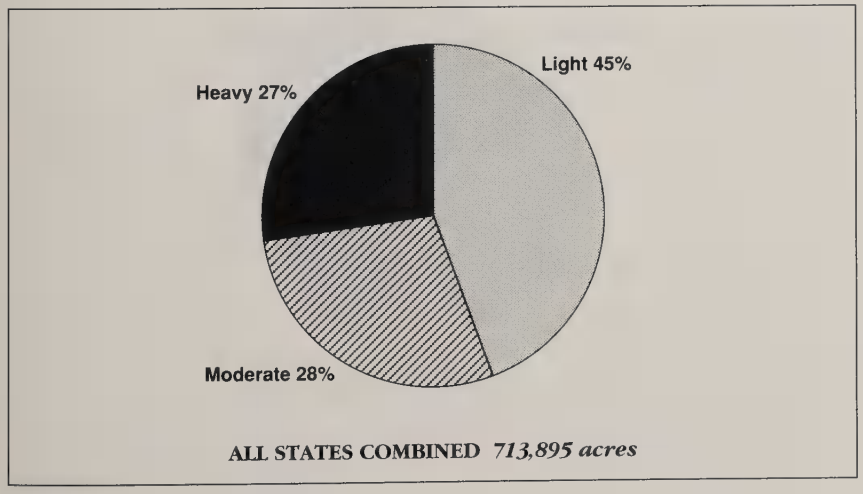


FIGURE 4.
Distribution of mortality (standing dead) for all states combined.

cent or more of the area surveyed was classified as light mortality. Vermont had the largest proportion of total area classified as light mortality (61 percent), however, the greatest area (136,504 acres) of light mortality was in Maine. Most of the light mortality in Maine was in spruce-fir slope. The distribution of mortality in New Hampshire was similar to the combined results.

The overall distribution of mortality within each cover type (all states combined) is shown in Figure 6. The area of mixedwood was only half the size of the spruce-fir slope, yet the distribution of mortality was similar. In both, most of the area was light mortality, however, the proportion of heavy mortality in the spruce-fir slope was slightly higher than in the mixedwood type. This difference largely is due to a higher occurrence of spruce-fir slope growing on exposed sites at elevations above 3,600 ft. At the higher elevations, over one-half of the spruce-fir slope type was classified as heavy mortality compared to about one-third in the mixed wood type (Table 2).

The largest proportion of heavy mortality was in the balsam fir type, while the smallest is in the spruce-fir swamp type (Figure 6). This difference in mortality levels between the two is most likely due to site differences. Almost all of the balsam fir type had moderate or heavy mortality. These forests are on harsh sites with very shallow soils. Much of the balsam fir contains fir waves from repeated winter damage. These patterns of tree mortality and vigorous regeneration of the overstory species occur in the subalpine regions of the northeast (Marchand 1984). Fir waves occur near the upper limits of forest growth (between 3,600 and 5,000 ft elevation) on sites with high exposure to wind (Sprugel 1976). The cyclic pattern of fir waves is noticeable, particularly on CIR photos, because of the distinct dieback fronts of standing dead and dying trees (Reiners and Lang 1979). In areas of balsam fir with heavy mortality, fir waves were found to be prevalent in New Hampshire and Maine (an estimate of 42 and 44 percent of the area, respectively). Fir waves

were not as common in New York and Vermont (an estimate of 27 and 11 percent of the area, respectively). Fir waves also were less common in all states in the moderate and light mortality classifications.

In contrast to these harsh subalpine sites, the more moderate, low-lying spruce-fir swamp sites, which mostly occur below 2,600 ft, had the greatest proportion of area of light mortality. The soils are wet, deep, and usually high in organic matter. These sites are more sheltered, and have a lower incidence of winter injury and weather damage. The trees sometimes are killed by sudden elevation of the water table due to flooding from beaver dams or human activity.

Generally, the higher elevations contained the greatest proportion of areas classified as having heavy mortality (Table 3). The proportion of spruce-fir slope, with greater than 30 percent standing dead, was lowest in Vermont and highest in New York. These results are presented for red spruce and balsam fir combined, since the distinction between red spruce and balsam fir was difficult to make during the photo interpretation. Based on this survey alone, it is not possible to say if this proportion of heavy mortality (standing dead) is what would be expected.

A further discussion of the relationships between spruce-fir forest conditions and elevation is presented in each of the state sections. Acreage tables of cover type and mortality by elevation and mapping unit for each state are in Appendix A. ❧

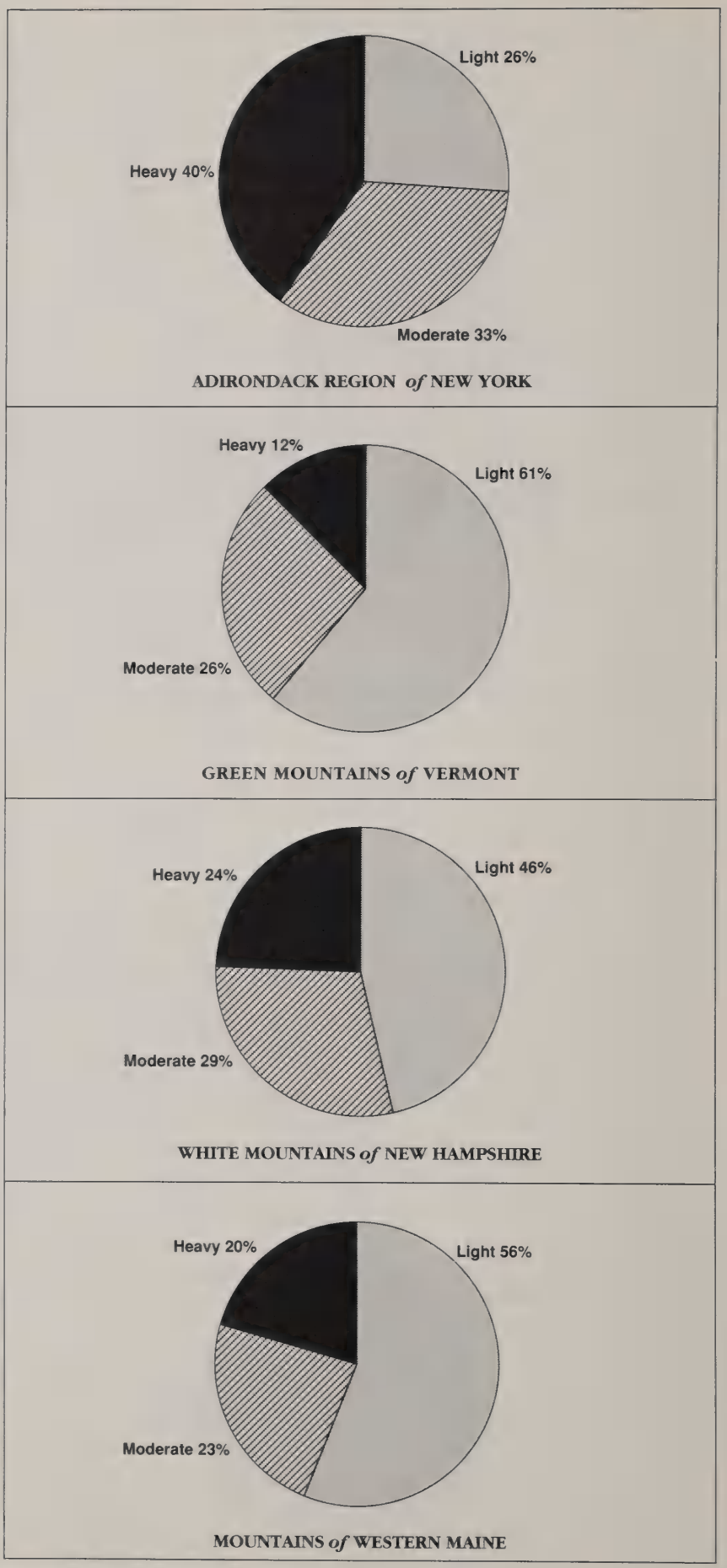


FIGURE 5.
Distribution of mortality (standing dead) within each state (all cover types combined).

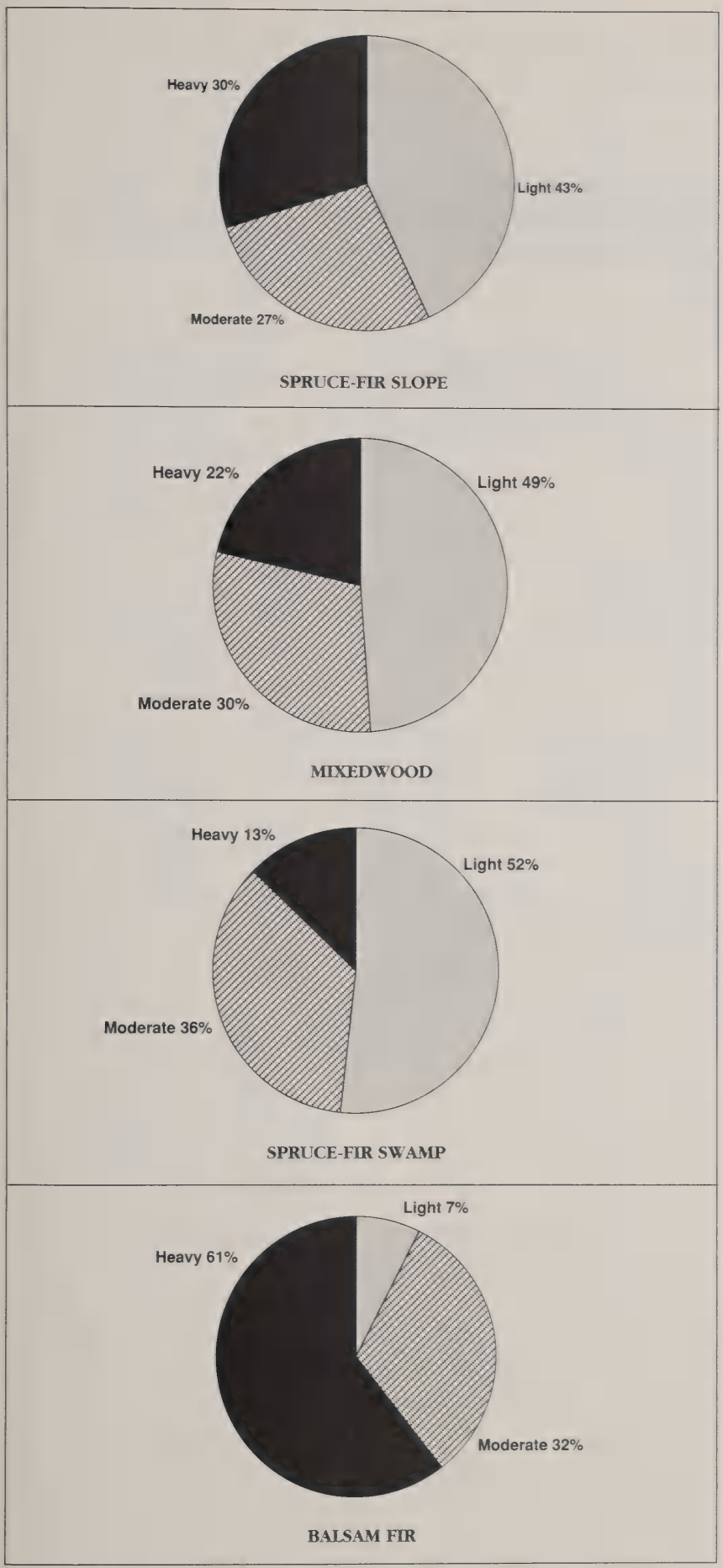


FIGURE 6.
Distribution of mortality (standing dead) within each spruce-fir cover type (all states combined).

TABLE 1

Area of spruce-fir cover type by mortality (standing dead) class in the Adirondack Region of New York, the Green Mountains of Vermont, the White Mountains of New Hampshire, and the mountains of western Maine (based on 1985 and 1986 aerial photography).

COVER TYPE & MORTALITY CLASS	STATES				
	New York	Vermont	New Hampshire	Maine	Total
			ACRES		
SPRUCE-FIR SWAMP:					
Light	14,57	6 876	1,300	1,515	18,267
Moderate	9,348	303	672	2,220	12,543
Heavy	1,701	31	403	2,327	4,462
Cover type total	25,625	1,210	2,375	6,062	35,272
MIXEDWOOD:					
Light	18,006	18,394	32,163	39,842	108,405
Moderate	33,919	6,664	17,258	7,999	65,840
Heavy	33,872	3,654	8,044	2,360	47,930
Cover type total	85,797	28,712	57,465	50,201	222,175
SPRUCE-FIR SLOPE:					
Light	24,431	12,060	58,639	94,795	189,925
Moderate	28,856	6,032	37,577	46,410	118,875
Heavy	49,583	2,214	35,599	44,110	131,506
Cover type total	102,870	20,306	131,815	185,315	440,306
BALSAM FIR:					
Light	135	272	440	352	1,199
Moderate	1,496	650	2,671	354	5,171
Heavy	3,851	545	4,618	758	9,772
Cover type total	5,482	1,467	7,729	1,464	16,142
ALL COVER TYPES:					
Light	57,148	31,602	92,542	136,504	317,796
Moderate	73,619	13,649	58,178	56,983	202,429
Heavy	89,007	6,444	48,664	49,555	193,670
STATE TOTAL	219,774	51,695	199,384	243,042	713,895

TABLE 2

Area of spruce-fir cover type and mortality (standing dead) class by elevation within the survey area; Adirondack Region of New York, Green Mountains of Vermont, White Mountains of New Hampshire, and mountains of western Maine combined (based on 1985 and 1986 aerial photography).

COVER TYPE & MORTALITY CLASS	ELEVATION <2600 FT	2600- 3600 FT	3600- 4600 FT	>4600 FT	TOTAL
			ACRES		
SPRUCE-FIR SWAMP:					
Light	17,883	384	0	0	18,267
Moderate	12,365	178	0	0	12,543
Heavy	4,289	173	0	0	4,462
Cover type total	34,537	735	0	0	35,272
MIXEDWOOD:					
Light	80,389	26,728	1,288	0	108,405
Moderate	34,135	28,959	2,746	0	65,840
Heavy	25,083	20,853	1,987	7	47,930
Cover type total	139,607	76,540	6,021	7	222,175
SPRUCE-FIR SLOPE:					
Light	133,057	49,621	7,150	97	189,925
Moderate	50,369	57,727	10,684	95	118,875
Heavy	27,573	82,472	21,237	224	131,506
Cover type total	210,999	189,820	39,071	416	440,306
BALSAM FIR:					
Light	258	344	438	159	1,199
Moderate	79	1,265	3,184	643	5,171
Heavy	17	2,034	7,312	409	9,772
Cover type total	354	3,643	10,934	1,211	16,142
TOTAL	385,497	270,738	56,026	1,634	713,895

TABLE 3

Proportion of cover type in each elevation classified as heavy mortality with greater than 30 percent standing dead trees in the Adirondack Region of New York, the Green Mountains of Vermont, the White Mountains of New Hampshire, and the mountains of western Maine (based on 1985 and 1986 aerial photography).[a]

STATE & COVER TYPE	ELEVATION			
	<2600 FT	2600-3600 FT	3600-4600 FT	>4600 FT
	PERCENT			
ADIRONDACK REGION OF NEW YORK:				
Spruce-fir swamp	7	0	—	—
Mixedwood	38	42	39	100[b]
Spruce-fir slope	24	60	71	65
Balsam fir	—	69	72	56
GREEN MOUNTAINS OF VERMONT:				
Spruce-fir swamp	4	0	—	—
Mixedwood	4	23	31	—
Spruce-fir slope	2	20	26	—
Balsam fir	5	43	56	—
WHITE MOUNTAINS OF NEW HAMPSHIRE:				
Spruce-fir swamp	17	26	—	—
Mixedwood	8	20	28	—
Spruce-fir slope	9	37	45	50
Balsam fir	0[b]	67	64	28
MOUNTAINS OF WESTERN MAINE:				
Spruce-fir swamp	37	100	—	—
Mixedwood	5	4	—	—
Spruce-fir slope	12	39	55	—
Balsam fir	—	42	71	—

[a] *A cover type that did not occur within a particular elevation is indicated by (—).*

[b] *Less than 10 acres of cover type occurred at this elevation.*

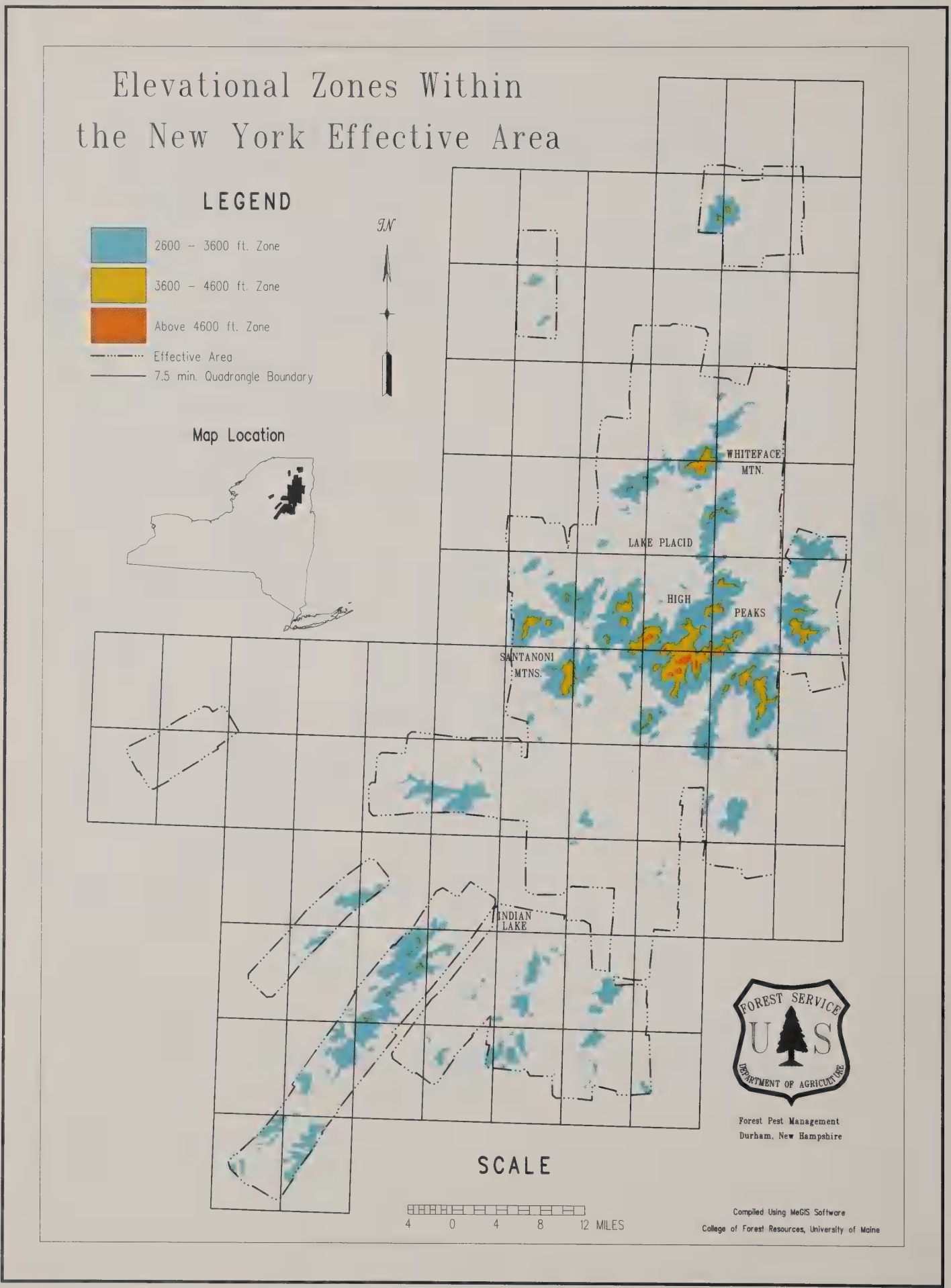

Elevational Zones Within
the New York Effective Area
LEGEND
2600 – 3600 ft. Zone
3600 – 4600 ft. Zone
Above 4600 ft. Zone
Effective Area
7.5 min. Quadrangle Boundary
N
Map Location
WHITEFACE MTN.
LAKE PLACID
HIGH PEAKS
SANTANONI MTNS.
INDIAN LAKE
FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE
Forest Pest Management
Durham, New Hampshire
SCALE
4 0 4 8 12 MILES
Compiled Using MeGIS Software
College of Forest Resources, University of Maine

FIGURE NY1.

ADIRONDACK REGION *of* NEW YORK

The Adirondack Park, in northern New York, is a unique physiographic region. Geologically, the Adirondacks are the only mountains in the eastern United States not Appalachian in origin. Rather than being formed by parallel faulting and folding of the earth's crust, the more ancient Adirondack uplands were formed by uplifting of igneous materials, creating a domed land mass (Cressey 1966). Glaciation scoured the entire surface, leaving eroded mountains, irregular stream patterns and numerous lakes. The region can be divided into three land form areas. The High Peaks include the highest and most rugged area with elevations above 3,000 ft and local relief exceeding 2,000 ft. Mount Marcy is the highest point at 5,344 ft. The Adirondack Low Mountains surround the High Peaks, with local relief generally below 1,000 ft, and hundreds of glacial lakes are present. The western Adirondack Hills is a broad zone of foothills. There are additional areas of spruce in the Tug Hill and Catskill regions of New York that were not included in this survey.

Similar to most of the Northeast, the Adirondack region was highly utilized for its resources through the 1800's. By the mid 1800's, this area helped New York lead the states in timber production. The area also was known for its prestigious resorts. In the late 1800's, concerns over the future of the wilderness resulted in the creation of the first forested area in the United States to practice conservation. The Adirondack Park established state-owned forest preserves where reforestation and watershed protection were practiced and the preserves were to be kept forever as wild forest land. The Park now contains over 2.5 million acres of state-owned preserves and in the 1970's became the first significant area to experience comprehensive land use controls on private lands. The area surveyed in New York is comprised primarily of the state lands in the Adirondack Park region.

Since 1894, there has been limited commercial harvests on land within the region. Wide scale cutting was only allowed after the 1952 hurricane when affected areas were salvaged to reduce fire hazard. As a result of limited harvesting, there is now a predominance of mature stands in the spruce-fir forests.

Figure NY1 illustrates the elevations in the photographed area of New York. Figure NY2 shows the distribution of mortality (standing dead) by cover type and Figure NY3 shows the distribution by elevation. The relatively older age of the spruce-fir forests in the Adirondack Mountains, compared with the rest of the survey area, contributes to the greater moderate to heavy mortality in the mixedwood and spruce-fir slope cover types. Competition among the trees decreases growth and vigor which leads to increased susceptibility to insects and pathogens. In some cases, large proportions of moderate and heavy mortality in mixedwood and spruce-fir slope is the result of an epidemic spruce beetle infestation—a significant mortality factor in larger trees (Souto and McCreery 1988). Dwarf mistletoe and root rots are also factors in these older stands.

About two-thirds of the spruce-fir slope occurred above 2,600 ft and a large proportion of the area exhibited heavy mortality. Below 2,600 ft, however, a greater proportion of light mortality occurred. Perhaps the reasons for this lower mortality is the better quality of the sites at lower elevations, which provides better growing conditions, and consequently more resistance to forest stressors.

Mixedwood was most prevalent below 2,600 ft where two-thirds of the type occurs. Another one-third was in the 2,600-to-3,600 ft zone. Very little mixedwood occurred above 3,600 ft. Over three-quarters of the mixed wood area had moderate or heavy mortality. As in the spruce-fir slope, the mixedwood had more areas with moderate and heavy mortality as elevation increased (up to 3600 ft).

Almost all of the balsam fir was concentrated in the Adirondack High Peaks covered

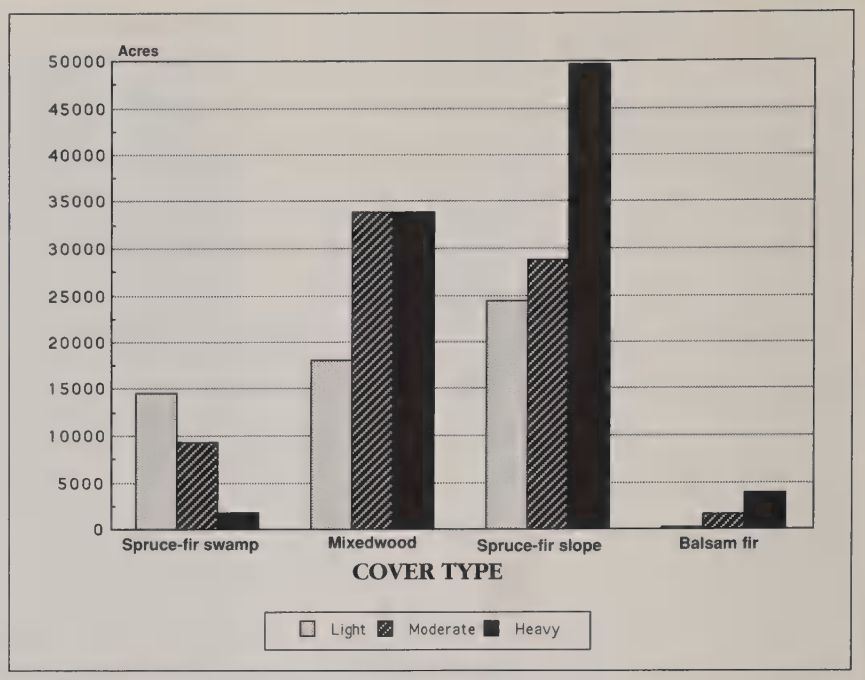


FIGURE NY2.
Distribution of mortality (standing dead) by cover type in the Adirondack Region of New York.

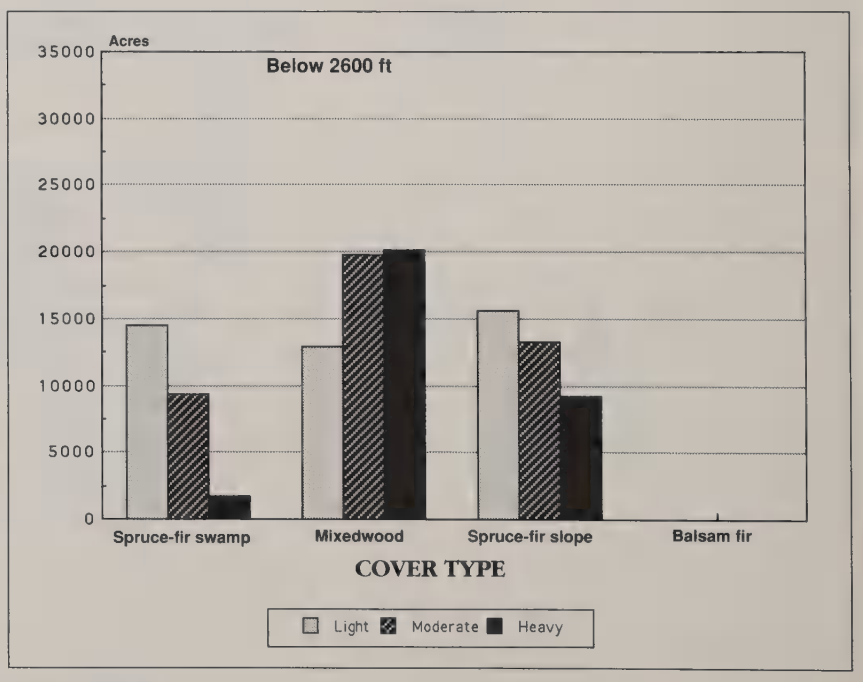


FIGURE NY3.
Distribution of mortality (standing head) by cover type and elevation in the Adirondack Region of New York.

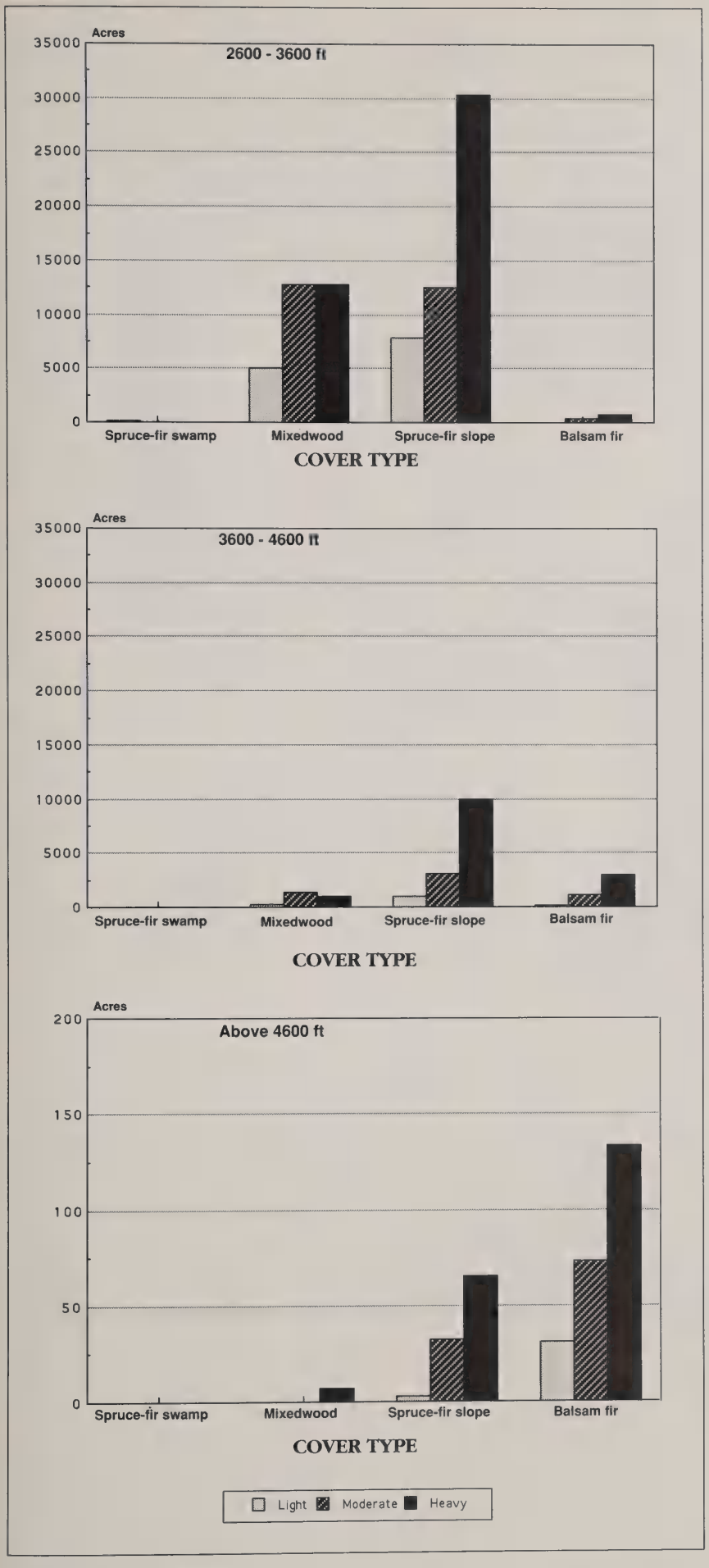


FIGURE NY3. CONTINUED
Distribution of mortality (standing dead) by cover type and elevation in the Adirondack Region of New York.

by New York Mapping Units Three, Four, and Five (Figure NY4). It dominated the small land area above 4,600 ft. The majority of the acreage occurred at elevations of 3,600-to-4,600 ft. Approximately 70 percent of the balsam fir was in the heavy mortality class and much of this occurred within fir waves. Fir waves were estimated to occur in 27 percent of the area with heavy mortality class and 10 percent of the moderate mortality area.

Spruce-fir swamp generally was healthy, with about one-half of its acreage light mortality and one-third moderate mortality. Compared with the other states, New York contained the largest acreage of spruce-fir swamp and almost all of that is concentrated at elevations below 2,600 ft, due to the topography of the Adirondacks. The mountains are more dome-like with fewer steep slopes than the other states. Spruce-fir swamp was distributed across the Adirondacks, occurring in the low mountains and western hills in flats near streams, and in notches in the high peaks.

Figure NY4 is an index of the fourteen mapping units in New York. Figures NY5-NY30 display the cover types and mortality in each unit. Figure NY31 shows the analysis of the standing dead spruce and fir on Whiteface Mountain. Included are all spruce-fir stands above, or passing through, the 2,600 ft contour. On this particular mountain, nearly 92 percent of the total spruce-fir forest was in the moderate and heavy mortality classes (with many of the standing dead trees in the balsam fir type located within fir waves at the higher elevations). Numerous research projects are being conducted on Whiteface Mountain to determine the status of the forest resource and assess various forest stressors (Battles et al. 1988). ❧

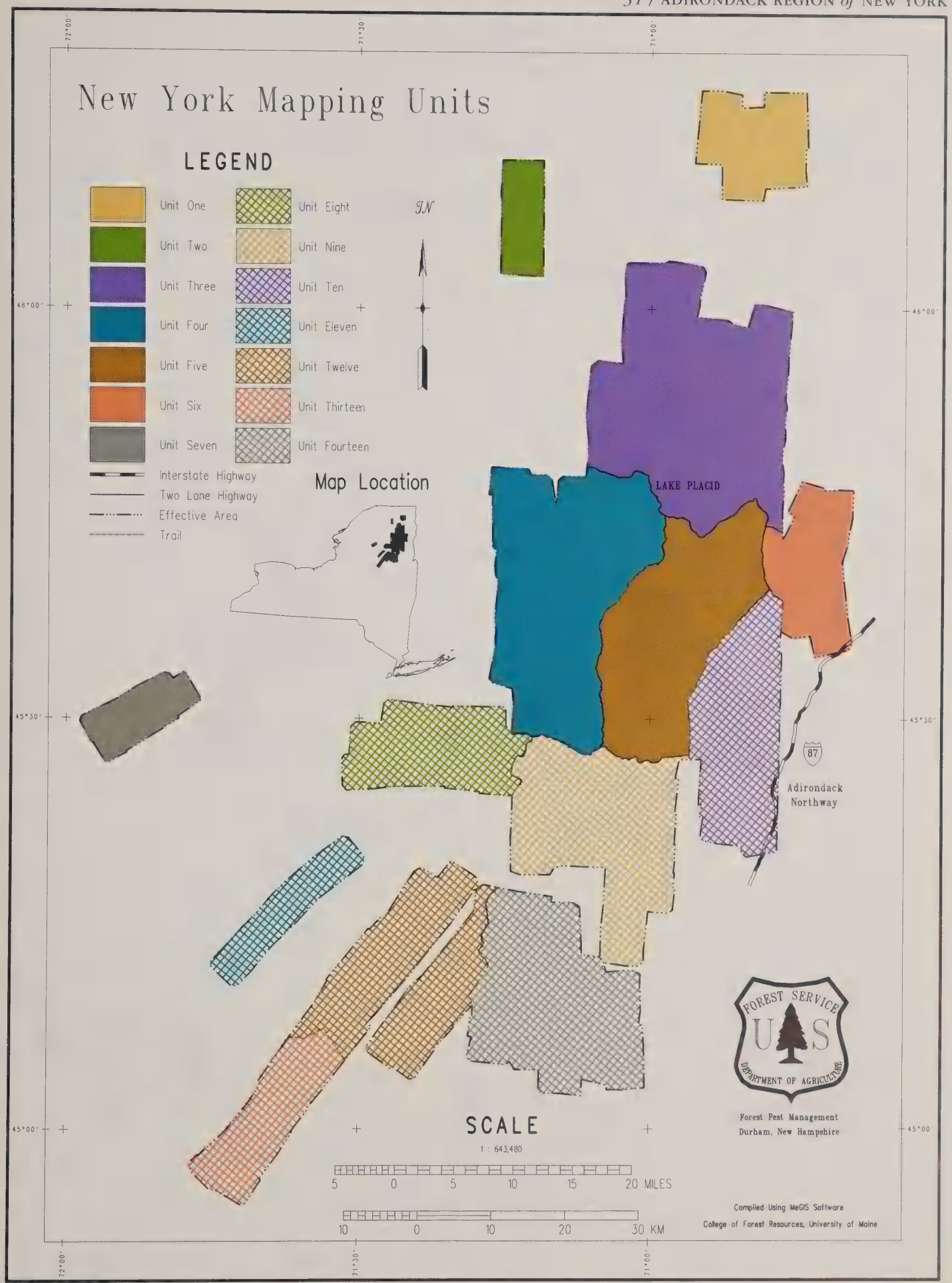

New York Mapping Units
LEGEND
Unit One
Unit Two
Unit Three
Unit Four
Unit Five
Unit Six
Unit Seven
Unit Eight
Unit Nine
Unit Ten
Unit Eleven
Unit Twelve
Unit Thirteen
Unit Fourteen
Interstate Highway
Two Lane Highway
Effective Area
Trail
Map Location
LAKE PLACID
87
Adirondack Northway
72°00'
71°30'
71°00'
46°00'
45°30'
45°00'
SCALE
1 : 643,480
5 0 5 10 15 20 MILES
10 0 10 20 30 KM
FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE
Forest Pest Management
Durham, New Hampshire
Compiled Using MeGIS Software
College of Forest Resources, University of Maine

FIGURE NY4.

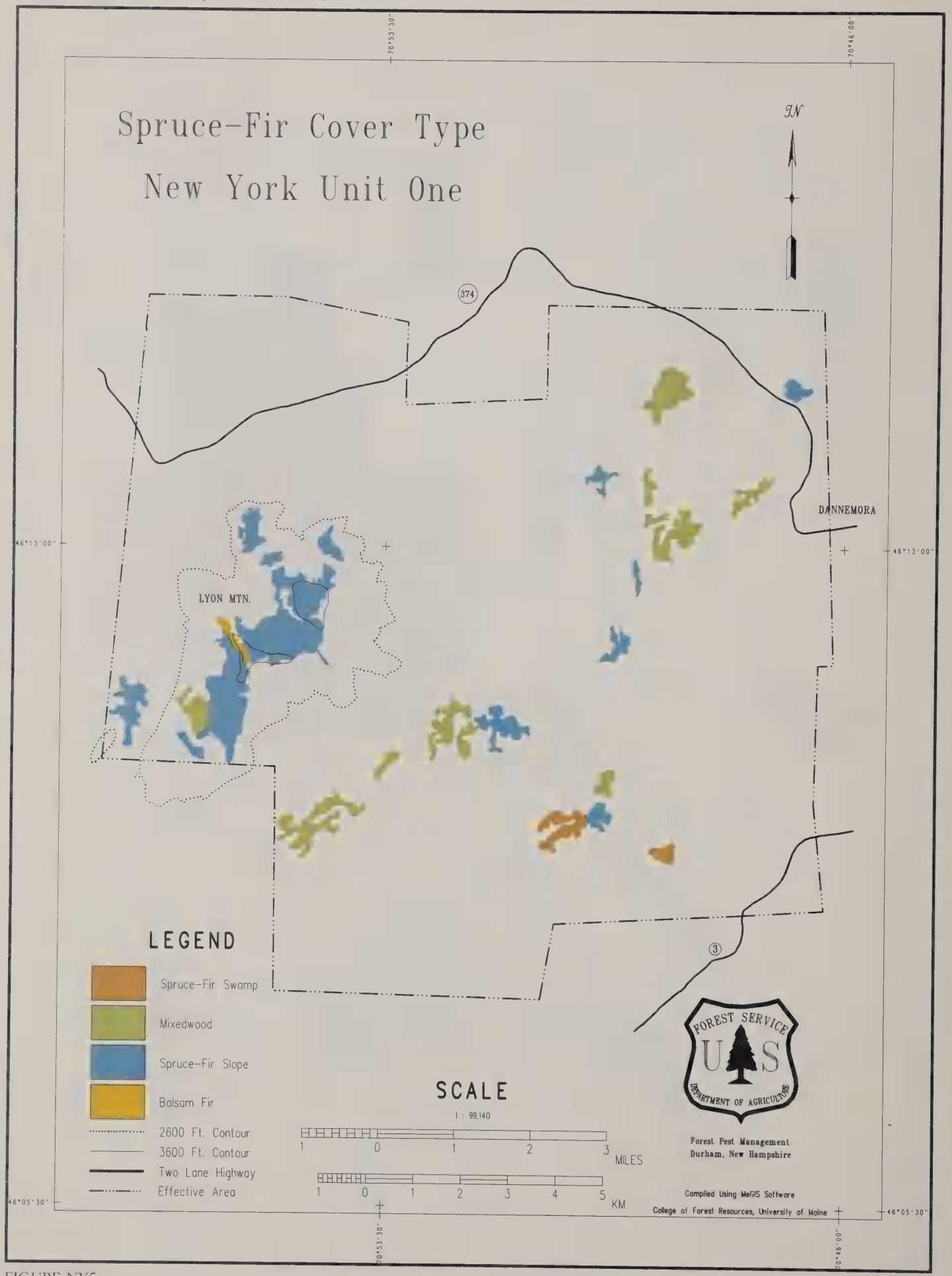

Spruce-Fir Cover Type
New York Unit One
N
374
DANNEMORA
LYON MTN.
70°53'30"
70°46'00"
46°13'00"
46°05'30"
LEGEND
Spruce-Fir Swamp
Mixedwood
Spruce-Fir Slope
Balsam Fir
2600 Ft. Contour
3600 Ft. Contour
Two Lane Highway
Effective Area
SCALE
1 : 99,140
1 0 1 2 3 MILES
1 0 1 2 3 4 5 KM
FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE
Forest Pest Management
Durham, New Hampshire
Compiled Using MeGIS Software
College of Forest Resources, University of Maine

FIGURE NY5.

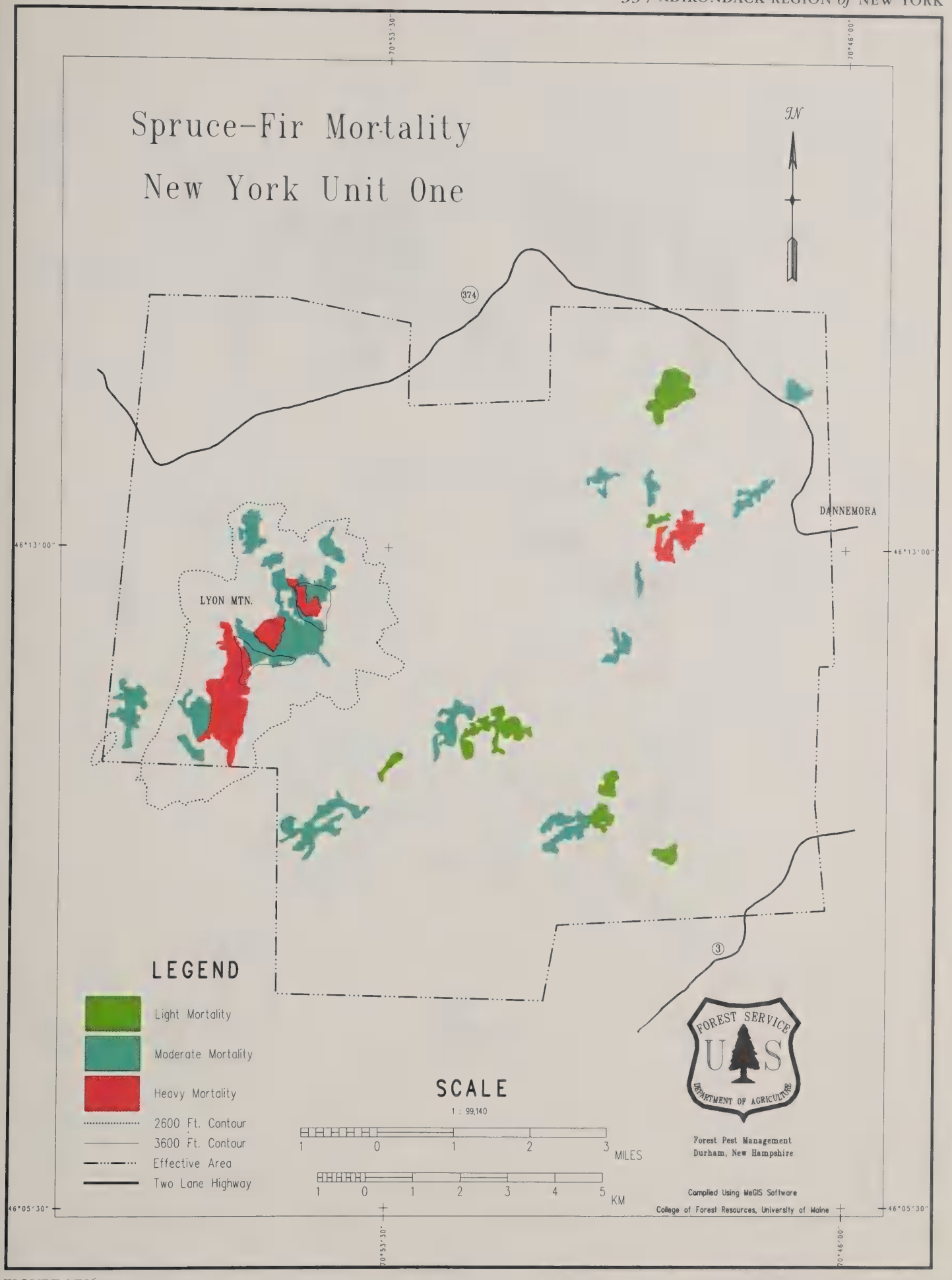

Spruce-Fir Mortality
New York Unit One
N
374
LYON MTN.
DANNEMORA
70°53'30"
70°46'00"
46°13'00"
46°05'30"
LEGEND
Light Mortality
Moderate Mortality
Heavy Mortality
2600 Ft. Contour
3600 Ft. Contour
Effective Area
Two Lane Highway
SCALE
1 : 99,140
1 0 1 2 3 MILES
1 0 1 2 3 4 5 KM
FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE
Forest Pest Management
Durham, New Hampshire
Compiled Using MeGIS Software
College of Forest Resources, University of Maine

FIGURE NY6.

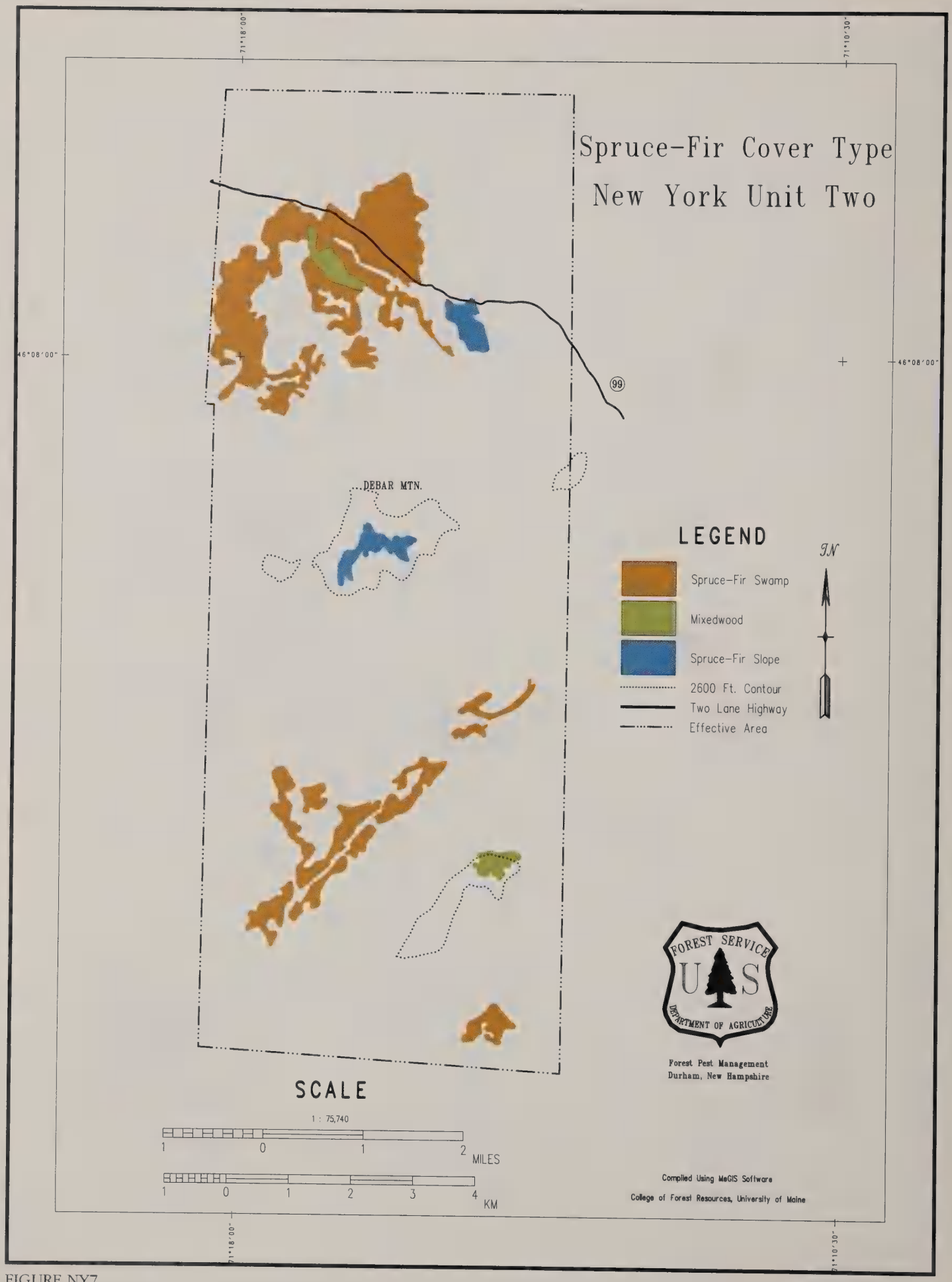

Spruce-Fir Cover Type
New York Unit Two
71°18'00"
71°10'30"
46°08'00"
99
DEBAR MTN.
LEGEND
Spruce-Fir Swamp
Mixedwood
Spruce-Fir Slope
2600 Ft. Contour
Two Lane Highway
Effective Area
N
SCALE
1 : 75,740
1 0 1 2 MILES
1 0 1 2 3 4 KM
FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE
Forest Pest Management
Durham, New Hampshire
Compiled Using MaGIS Software
College of Forest Resources, University of Maine

FIGURE NY7.

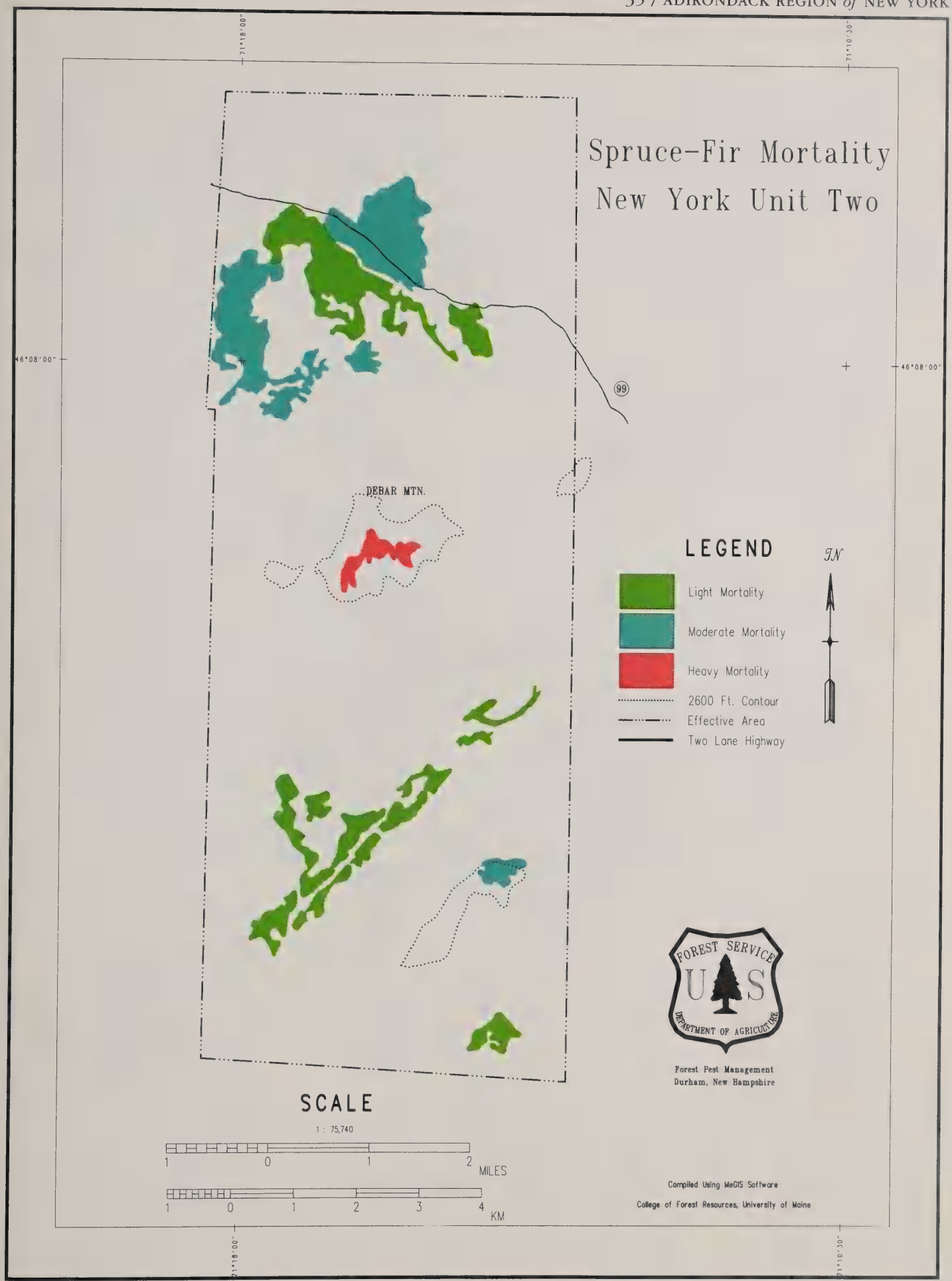

Spruce-Fir Mortality
New York Unit Two
71°18'00"
71°10'30"
46°08'00"
99
DEBAR MTN.
LEGEND
Light Mortality
Moderate Mortality
Heavy Mortality
2600 Ft. Contour
Effective Area
Two Lane Highway
N
FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE
Forest Pest Management
Durham, New Hampshire
SCALE
1 : 75,740
1 0 1 2 MILES
1 0 1 2 3 4 KM
Compiled Using MeGIS Software
College of Forest Resources, University of Maine

FIGURE NY8.

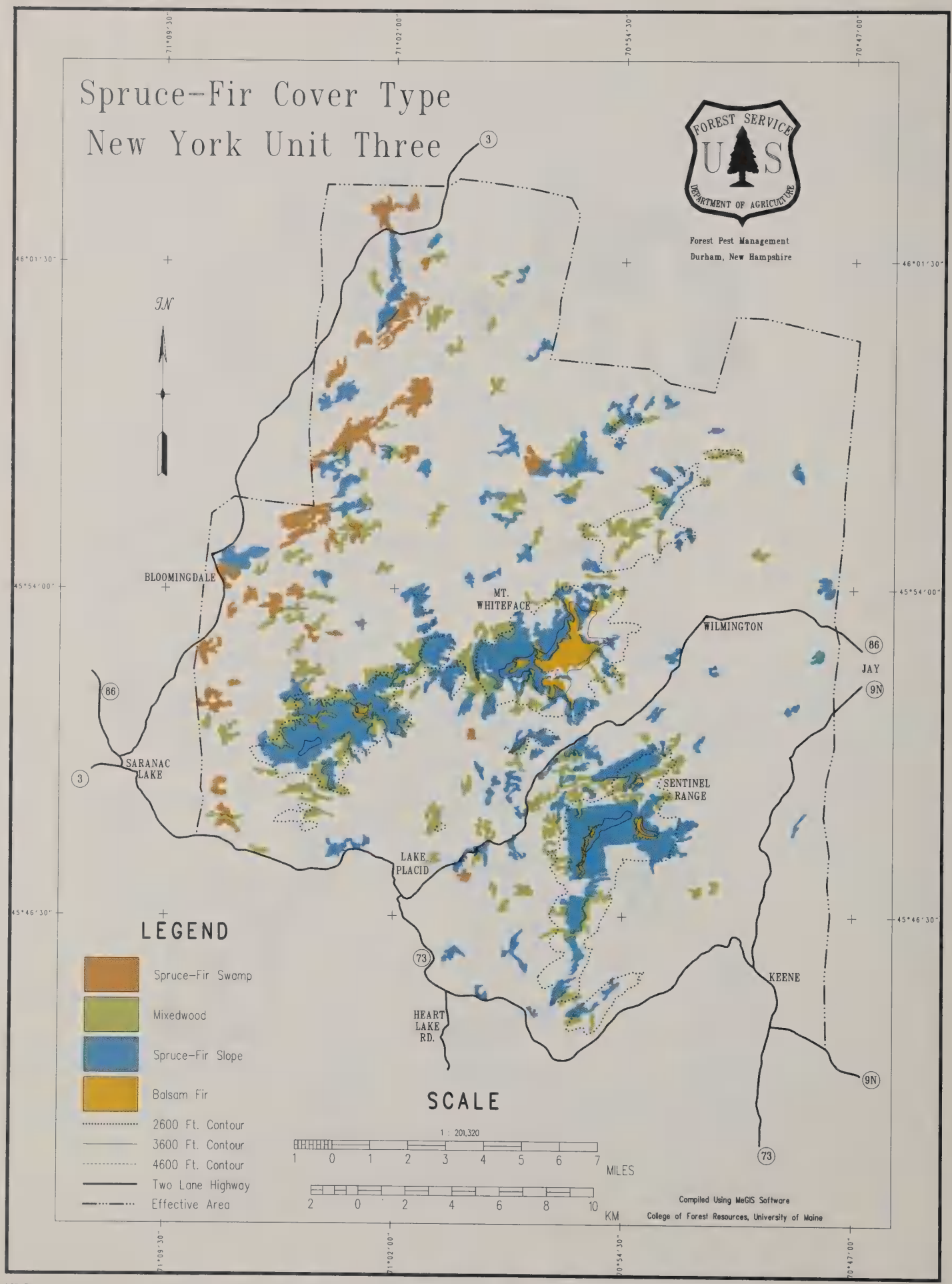

Spruce–Fir Cover Type
New York Unit Three
FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE
Forest Pest Management
Durham, New Hampshire
IN
BLOOMINGDALE
MT. WHITEFACE
WILMINGTON
JAY
SARANAC LAKE
SENTINEL RANGE
LAKE PLACID
KEENE
HEART LAKE RD.
LEGEND
Spruce–Fir Swamp
Mixedwood
Spruce–Fir Slope
Balsam Fir
2600 Ft. Contour
3600 Ft. Contour
4600 Ft. Contour
Two Lane Highway
Effective Area
SCALE
1 : 201,320
MILES
KM
Compiled Using MeGIS Software
College of Forest Resources, University of Maine

FIGURE NY9.

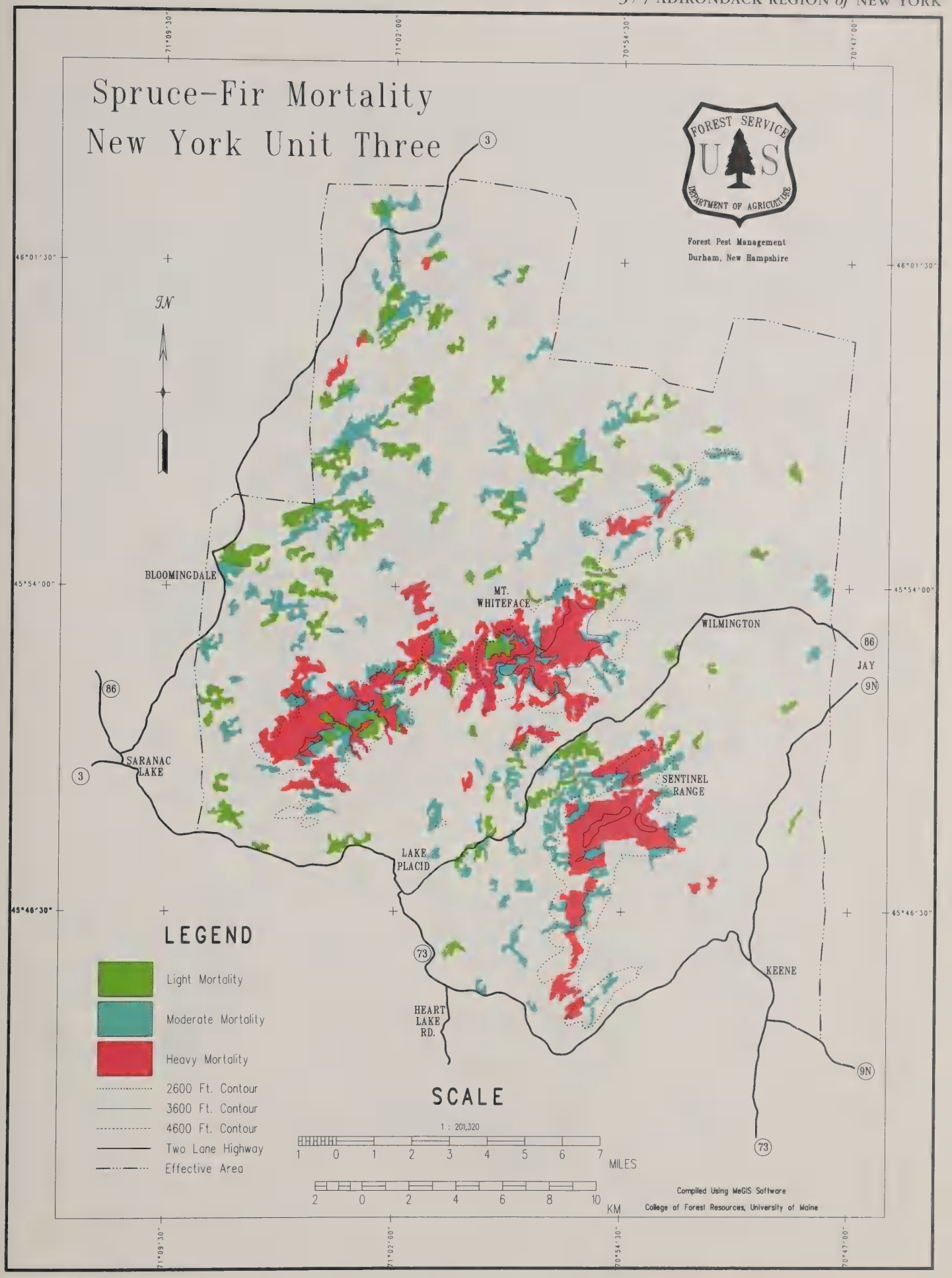

Spruce–Fir Mortality
New York Unit Three
FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE
Forest Pest Management
Durham, New Hampshire
71°09'30"
71°02'00"
70°54'30"
70°47'00"
46°01'30"
45°54'00"
45°46'30"
IN
BLOOMINGDALE
MT. WHITEFACE
WILMINGTON
JAY
SARANAC LAKE
SENTINEL RANGE
LAKE PLACID
KEENE
HEART LAKE RD.
3
86
9N
73
LEGEND
Light Mortality
Moderate Mortality
Heavy Mortality
2600 Ft. Contour
3600 Ft. Contour
4600 Ft. Contour
Two Lane Highway
Effective Area
SCALE
1 : 201,320
1 0 1 2 3 4 5 6 7
MILES
2 0 2 4 6 8 10
KM
Compiled Using MeGIS Software
College of Forest Resources, University of Maine

FIGURE NY10.

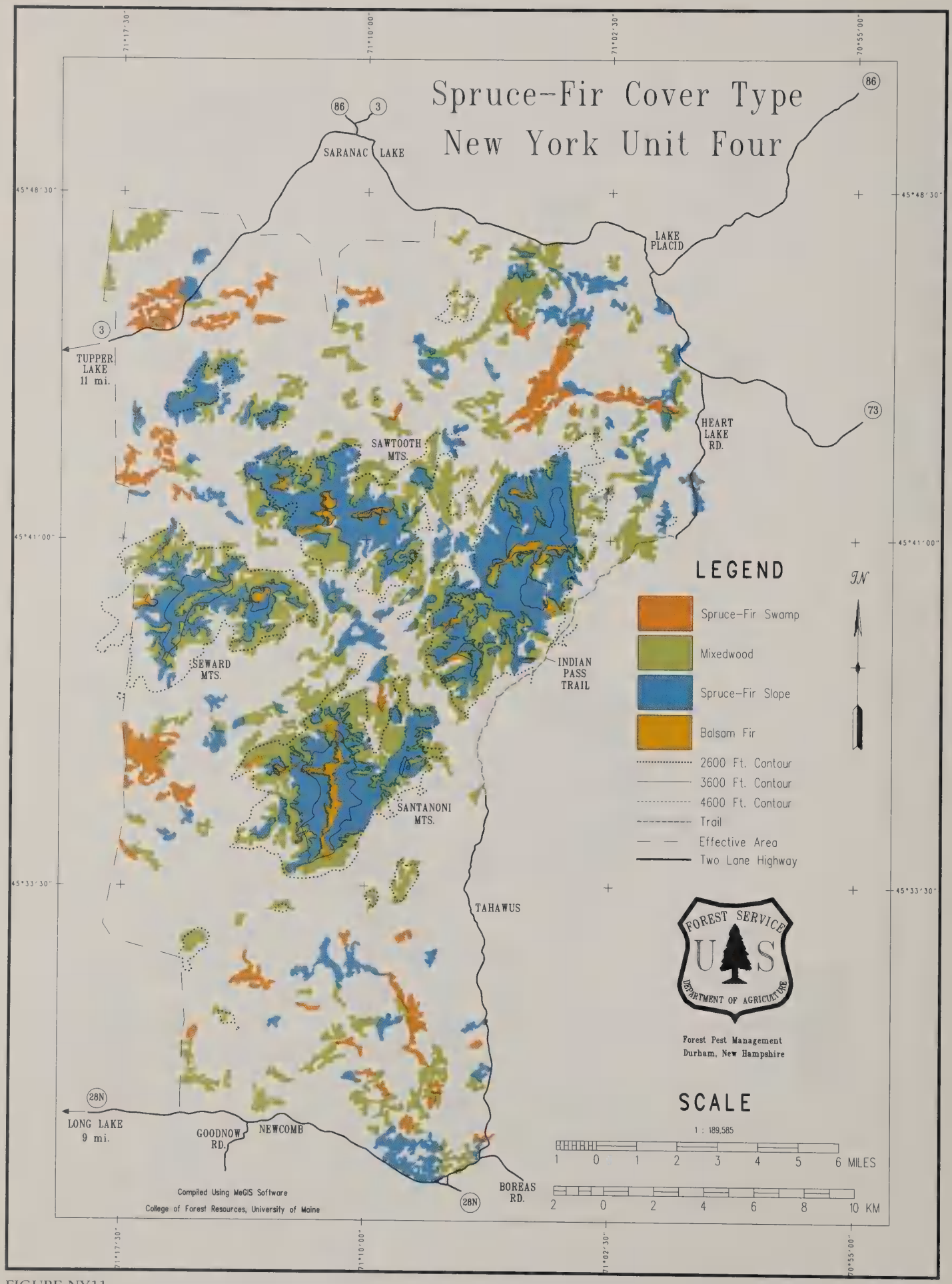

Spruce-Fir Cover Type
New York Unit Four
SARANAC LAKE
LAKE PLACID
TUPPER LAKE 11 mi.
HEART LAKE RD.
SAWTOOTH MTS.
SEWARD MTS.
INDIAN PASS TRAIL
SANTANONI MTS.
TAHAWUS
LONG LAKE 9 mi.
GOODNOW RD.
NEWCOMB
BOREAS RD.
LEGEND
Spruce-Fir Swamp
Mixedwood
Spruce-Fir Slope
Balsam Fir
2600 Ft. Contour
3600 Ft. Contour
4600 Ft. Contour
Trail
Effective Area
Two Lane Highway
FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE
Forest Pest Management
Durham, New Hampshire
SCALE
1 : 189,585
1 0 1 2 3 4 5 6 MILES
2 0 2 4 6 8 10 KM
Compiled Using MeGIS Software
College of Forest Resources, University of Maine

FIGURE NY11.

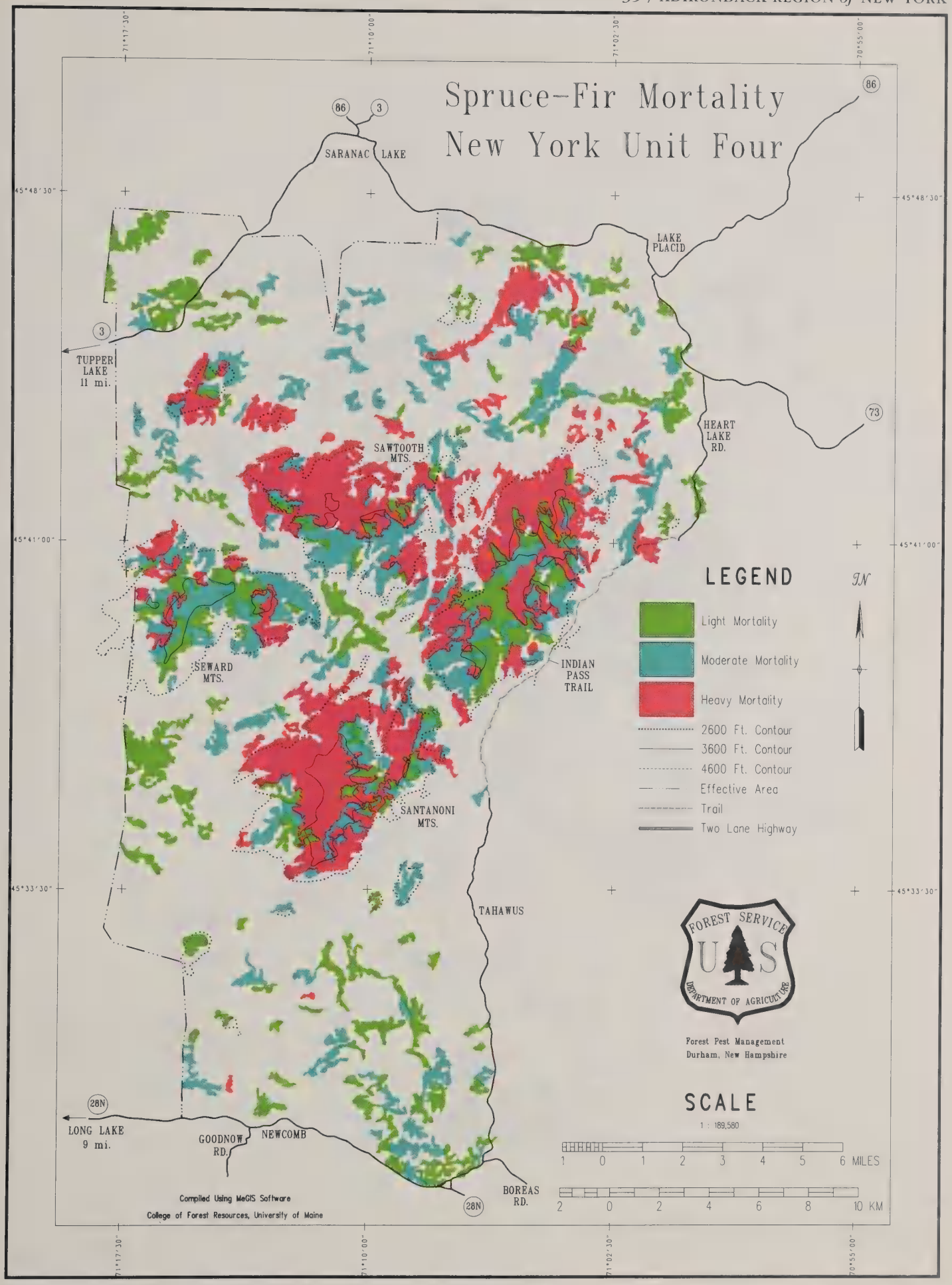

Spruce-Fir Mortality
New York Unit Four
SARANAC LAKE
LAKE PLACID
TUPPER LAKE 11 mi.
SAWTOOTH MTS.
HEART LAKE RD.
SEWARD MTS.
INDIAN PASS TRAIL
SANTANONI MTS.
TAHAWUS
LONG LAKE 9 mi.
GOODNOW RD.
NEWCOMB
BOREAS RD.
LEGEND
Light Mortality
Moderate Mortality
Heavy Mortality
2600 Ft. Contour
3600 Ft. Contour
4600 Ft. Contour
Effective Area
Trail
Two Lane Highway
FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE
Forest Pest Management
Durham, New Hampshire
SCALE
1 : 189,580
6 MILES
10 KM
Compiled Using MeGIS Software
College of Forest Resources, University of Maine

FIGURE NY12.

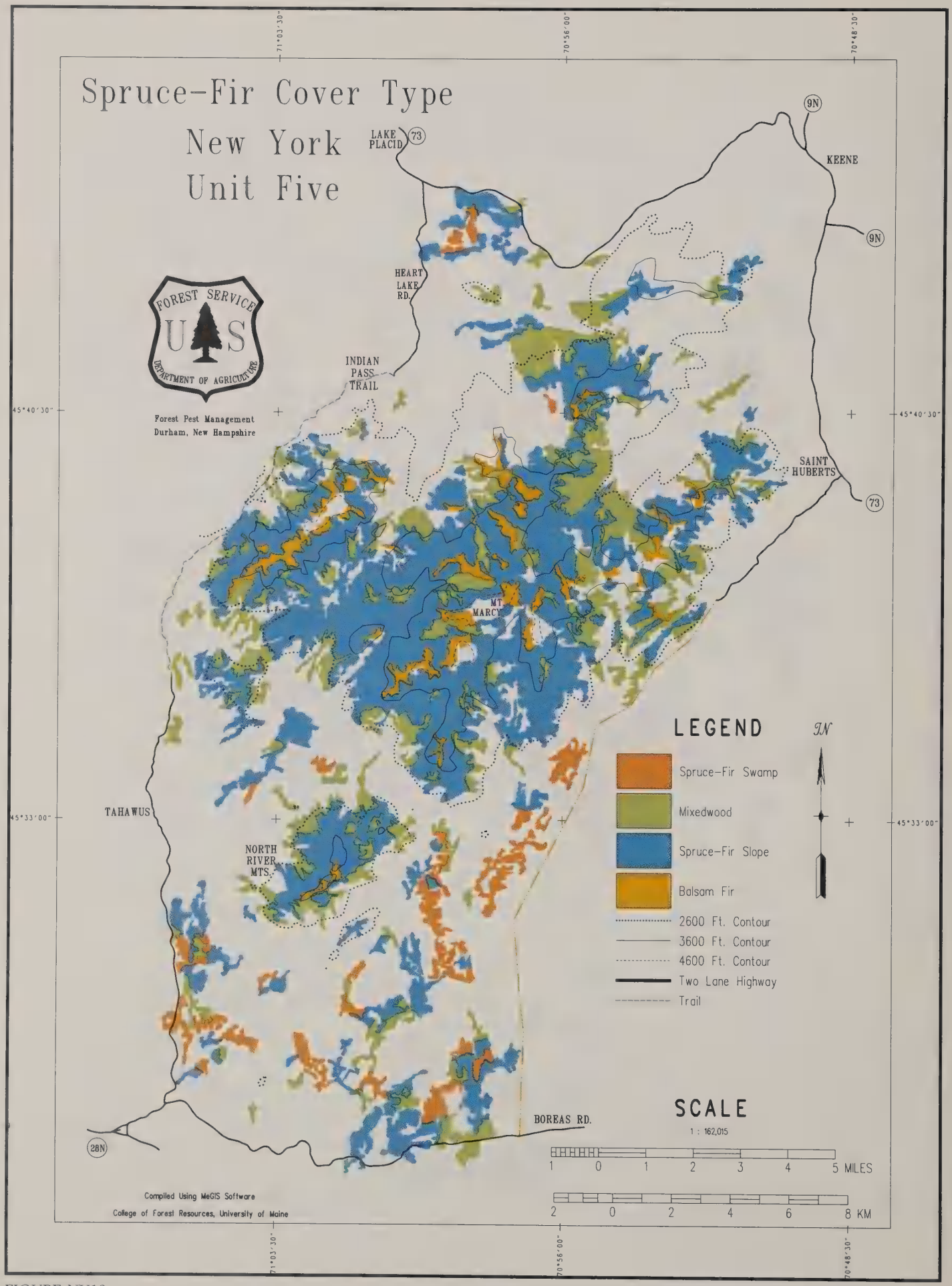

Spruce–Fir Cover Type
New York
Unit Five
FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE
Forest Pest Management
Durham, New Hampshire
LAKE PLACID
73
9N
KEENE
HEART LAKE RD.
INDIAN PASS TRAIL
SAINT HUBERTS
MT MARCY
TAHAWUS
NORTH RIVER MTS.
BOREAS RD.
28N
71°03'30"
70°56'00"
70°48'30"
45°40'30"
45°33'00"
LEGEND
Spruce–Fir Swamp
Mixedwood
Spruce–Fir Slope
Balsam Fir
2600 Ft. Contour
3600 Ft. Contour
4600 Ft. Contour
Two Lane Highway
Trail
N
SCALE
1 : 162,015
1 0 1 2 3 4 5 MILES
2 0 2 4 6 8 KM
Compiled Using MeGIS Software
College of Forest Resources, University of Maine

FIGURE NY13.

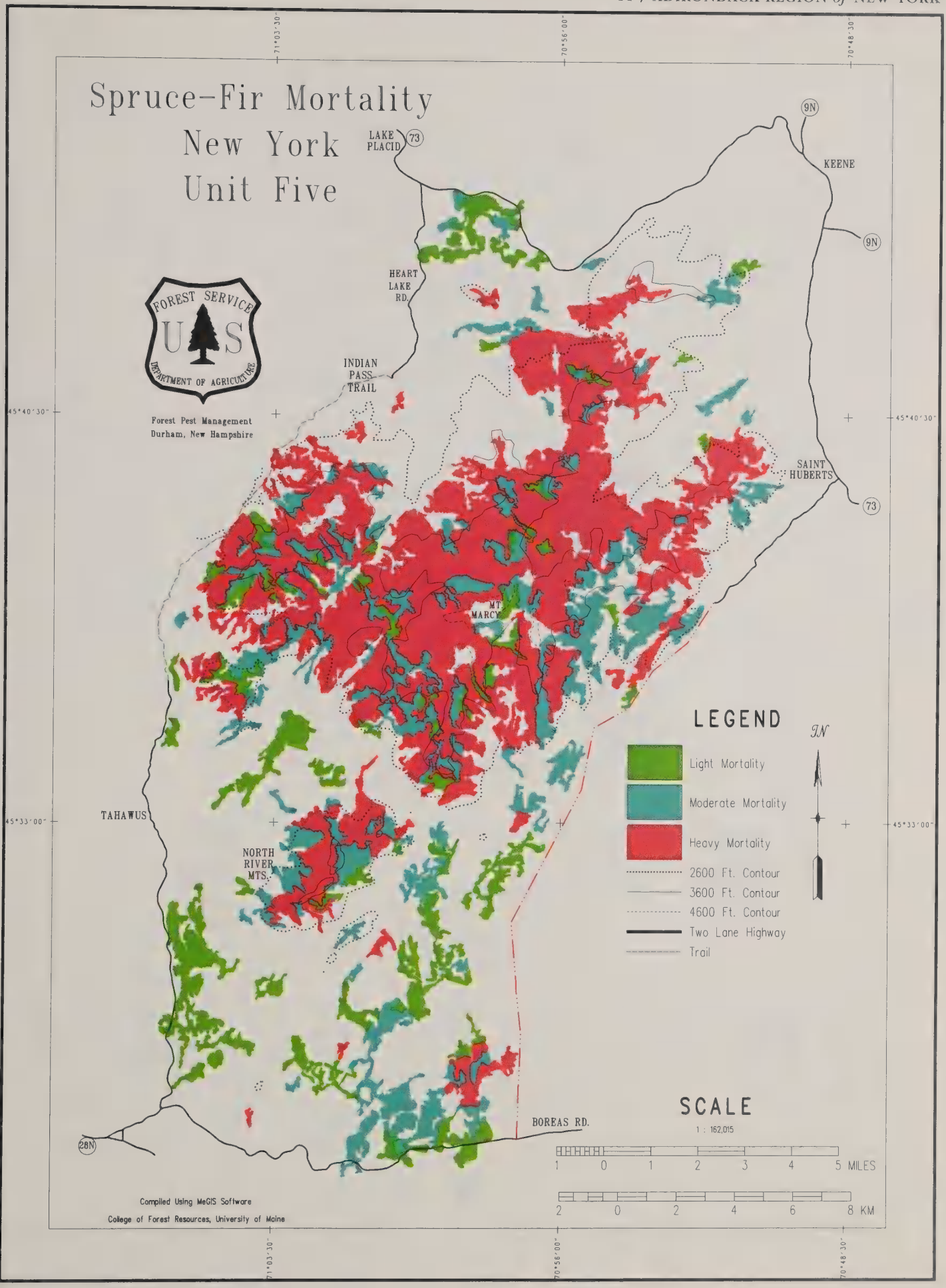

Spruce–Fir Mortality
New York
Unit Five
LAKE PLACID
73
9N
KEENE
HEART LAKE RD.
INDIAN PASS TRAIL
FOREST SERVICE
USDA
DEPARTMENT OF AGRICULTURE
Forest Pest Management
Durham, New Hampshire
SAINT HUBERTS
MT. MARCY
TAHAWUS
NORTH RIVER MTS.
28N
BOREAS RD.
71°03'30"
70°56'00"
70°48'30"
45°40'30"
45°33'00"
LEGEND
Light Mortality
Moderate Mortality
Heavy Mortality
2600 Ft. Contour
3600 Ft. Contour
4600 Ft. Contour
Two Lane Highway
Trail
N
SCALE
1 : 162,015
1 0 1 2 3 4 5 MILES
2 0 2 4 6 8 KM
Compiled Using MeGIS Software
College of Forest Resources, University of Maine

FIGURE NY14.

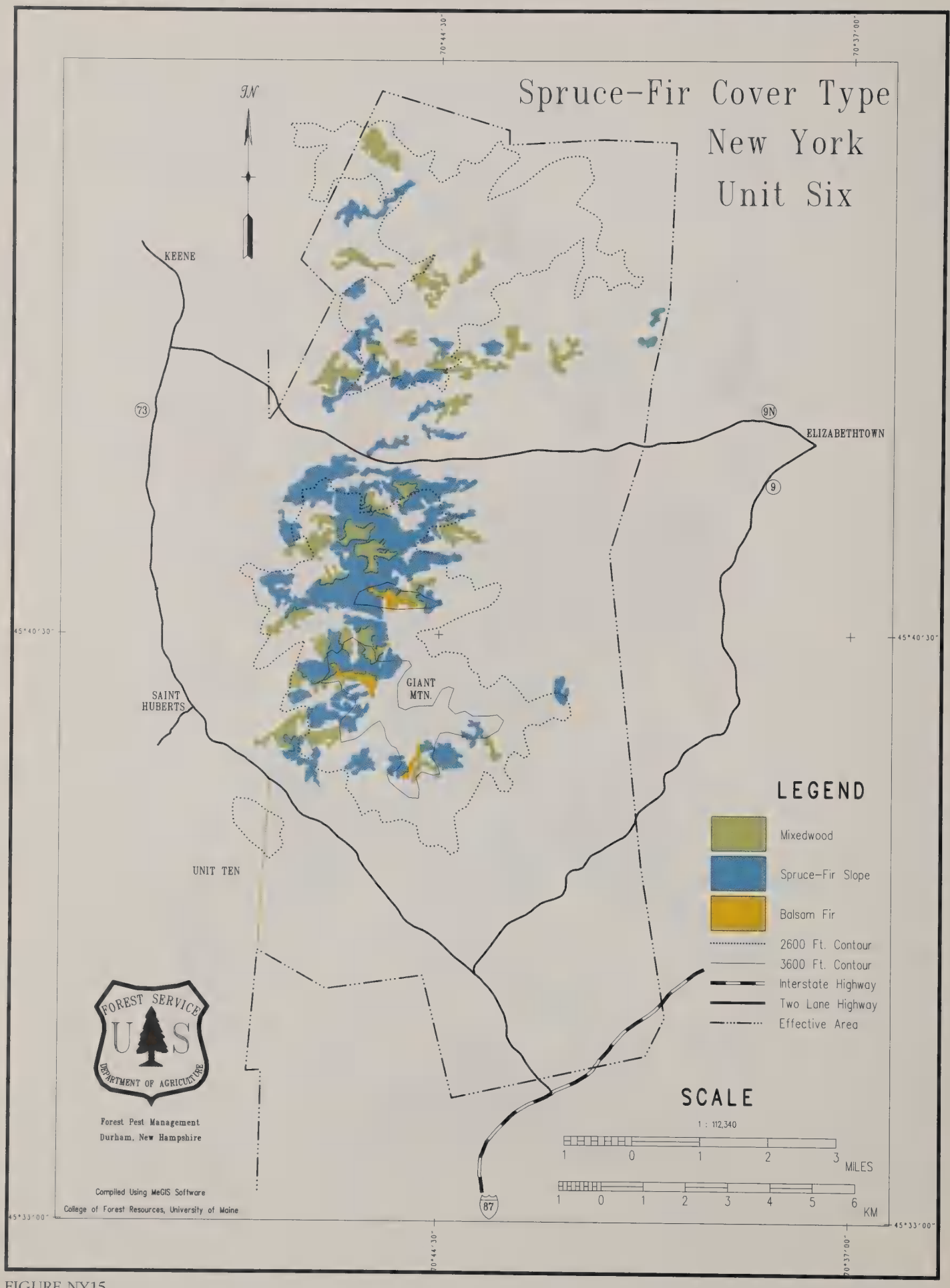

Spruce-Fir Cover Type
New York
Unit Six
KEENE
ELIZABETHTOWN
SAINT HUBERTS
GIANT MTN.
UNIT TEN
73
9N
9
87
LEGEND
Mixedwood
Spruce-Fir Slope
Balsam Fir
2600 Ft. Contour
3600 Ft. Contour
Interstate Highway
Two Lane Highway
Effective Area
SCALE
1 : 112,340
MILES
KM
FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE
Forest Pest Management
Durham, New Hampshire
Compiled Using MeGIS Software
College of Forest Resources, University of Maine
70°44'30"
70°37'00"
45°40'30"
45°33'00"

FIGURE NY15.

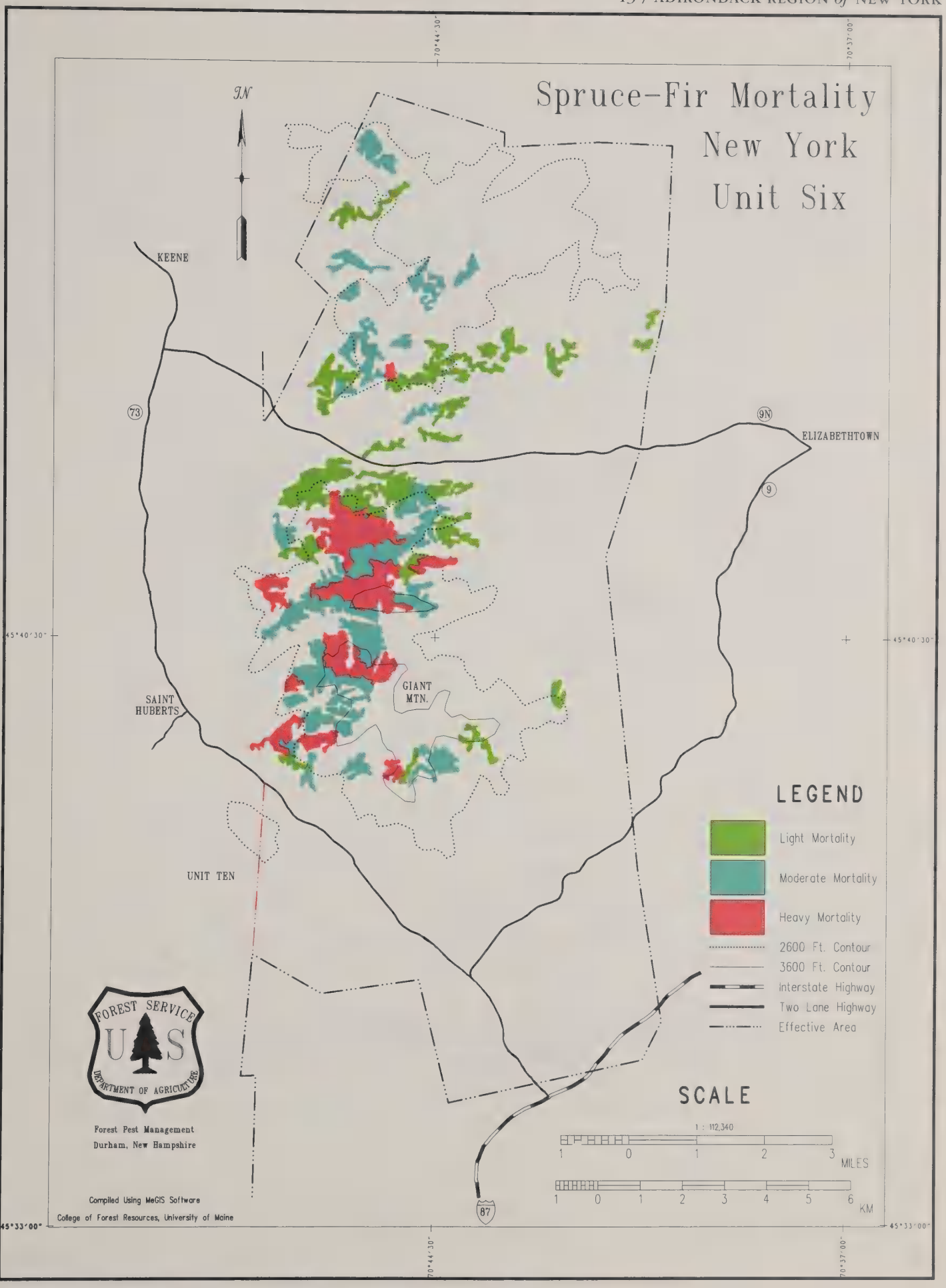

Spruce-Fir Mortality
New York
Unit Six
KEENE
ELIZABETHTOWN
SAINT HUBERTS
GIANT MTN.
UNIT TEN
73
9N
9
87
LEGEND
Light Mortality
Moderate Mortality
Heavy Mortality
2600 Ft. Contour
3600 Ft. Contour
Interstate Highway
Two Lane Highway
Effective Area
SCALE
1 : 112,340
MILES
KM
FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE
Forest Pest Management
Durham, New Hampshire
Compiled Using MeGIS Software
College of Forest Resources, University of Maine
70°44'30"
70°37'00"
45°40'30"
45°33'00"

FIGURE NY16.

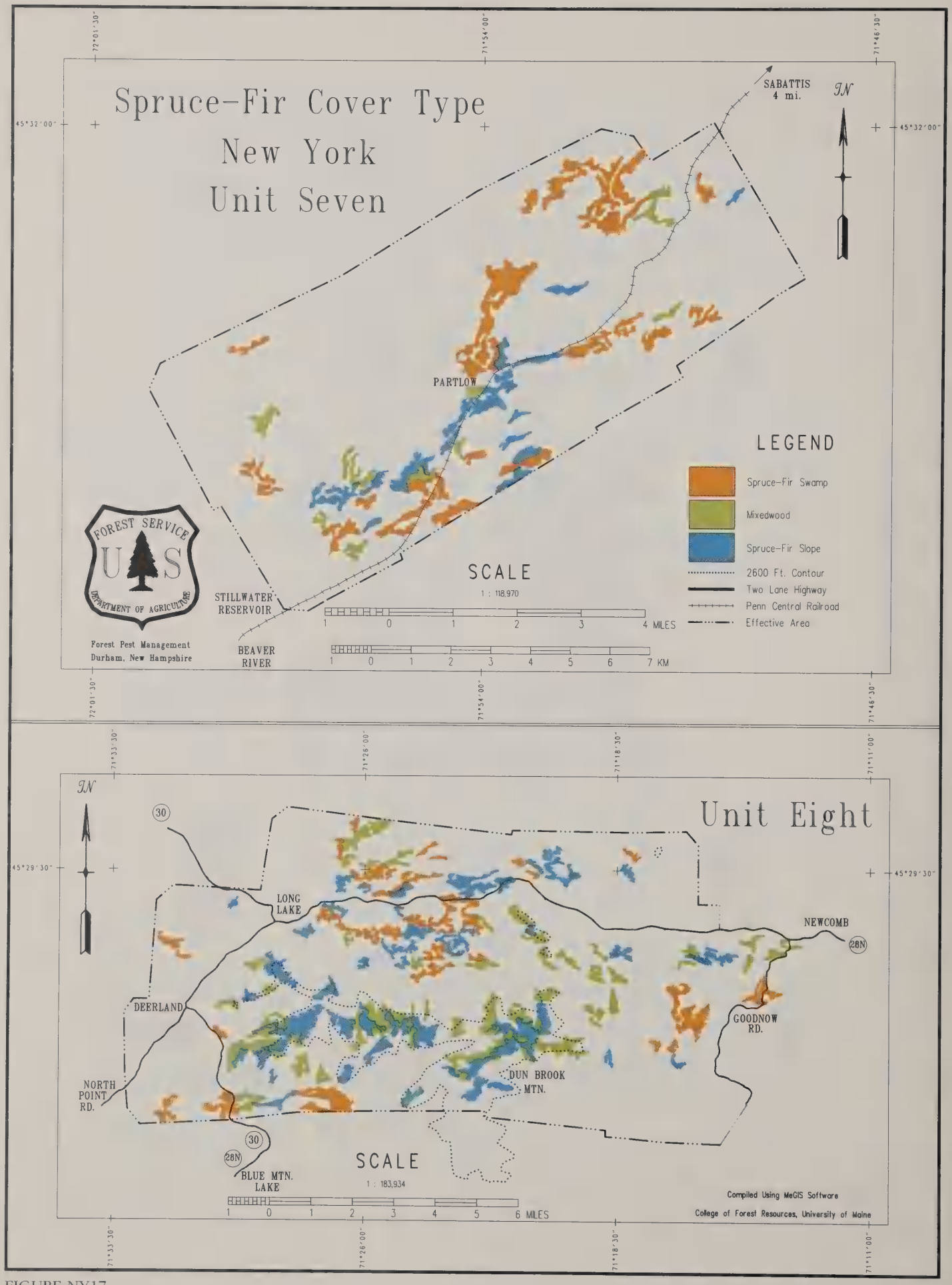

Spruce–Fir Cover Type
New York
Unit Seven
SABATTIS
4 mi.
N
PARTLOW
LEGEND
Spruce–Fir Swamp
Mixedwood
Spruce–Fir Slope
2600 Ft. Contour
Two Lane Highway
Penn Central Railroad
Effective Area
FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE
Forest Pest Management
Durham, New Hampshire
STILLWATER
RESERVOIR
BEAVER
RIVER
SCALE
1 : 118,970
1 0 1 2 3 4 MILES
1 0 1 2 3 4 5 6 7 KM
72°01'30"
71°54'00"
71°46'30"
45°32'00"
Unit Eight
N
30
LONG
LAKE
NEWCOMB
28N
DEERLAND
GOODNOW
RD.
DUN BROOK
MTN.
NORTH
POINT
RD.
BLUE MTN.
LAKE
SCALE
1 : 183,934
1 0 1 2 3 4 5 6 MILES
Compiled Using MeGIS Software
College of Forest Resources, University of Maine
45°29'30"
71°33'30"
71°26'00"
71°18'30"
71°11'00"

FIGURE NY17.

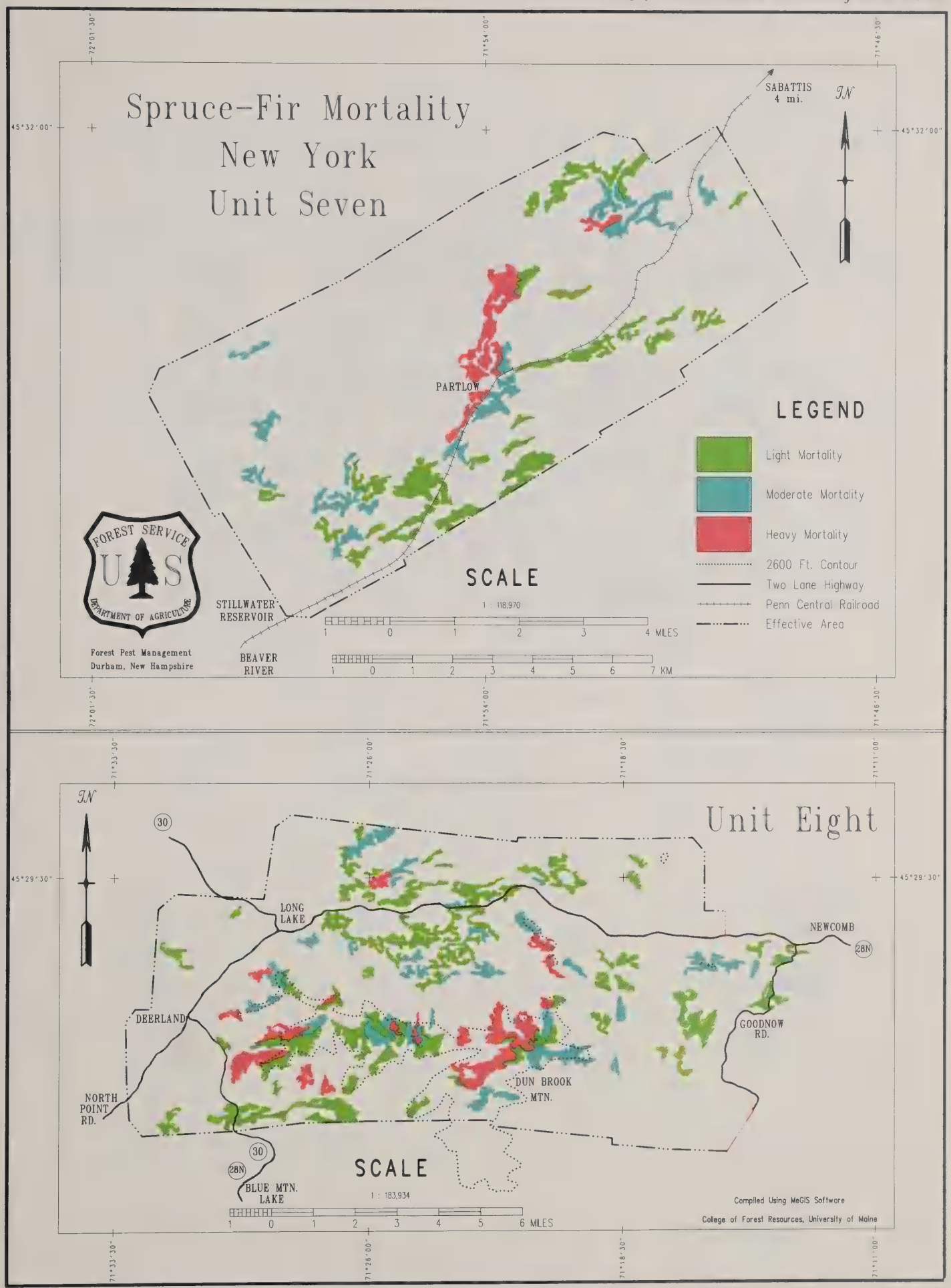

Spruce-Fir Mortality
New York
Unit Seven
SABATTIS
4 mi.
N
PARTLOW
LEGEND
Light Mortality
Moderate Mortality
Heavy Mortality
2600 Ft. Contour
Two Lane Highway
Penn Central Railroad
Effective Area
FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE
Forest Pest Management
Durham, New Hampshire
STILLWATER
RESERVOIR
BEAVER
RIVER
SCALE
1 : 118,970
1 0 1 2 3 4 MILES
1 0 1 2 3 4 5 6 7 KM
72°01'30"
71°54'00"
71°46'30"
45°32'00"
Unit Eight
N
30
LONG
LAKE
NEWCOMB
28N
DEERLAND
GOODNOW
RD.
DUN BROOK
MTN.
NORTH
POINT
RD.
BLUE MTN.
LAKE
SCALE
1 : 183,934
1 0 1 2 3 4 5 6 MILES
Compiled Using MeGIS Software
College of Forest Resources, University of Maine
45°29'30"
71°33'30"
71°26'00"
71°18'30"
71°11'00"

FIGURE NY18.

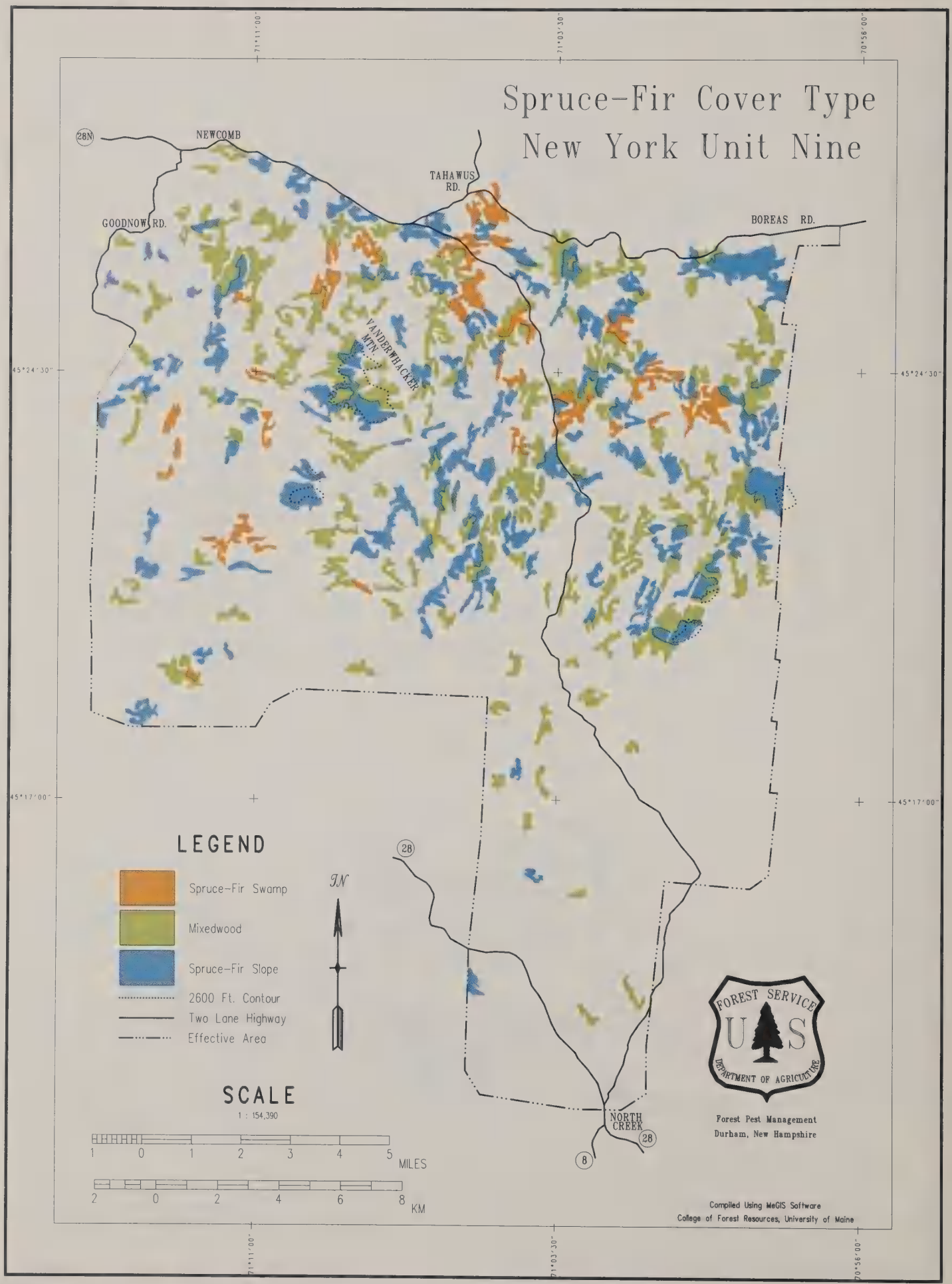

Spruce-Fir Cover Type
New York Unit Nine
NEWCOMB
TAHAWUS RD.
GOODNOW RD.
BOREAS RD.
VANDERWHACKER MTN.
NORTH CREEK
LEGEND
Spruce-Fir Swamp
Mixedwood
Spruce-Fir Slope
2600 Ft. Contour
Two Lane Highway
Effective Area
SCALE
1 : 154,390
MILES
KM
FOREST SERVICE
DEPARTMENT OF AGRICULTURE
Forest Pest Management
Durham, New Hampshire
Compiled Using MeGIS Software
College of Forest Resources, University of Maine

FIGURE NY19.

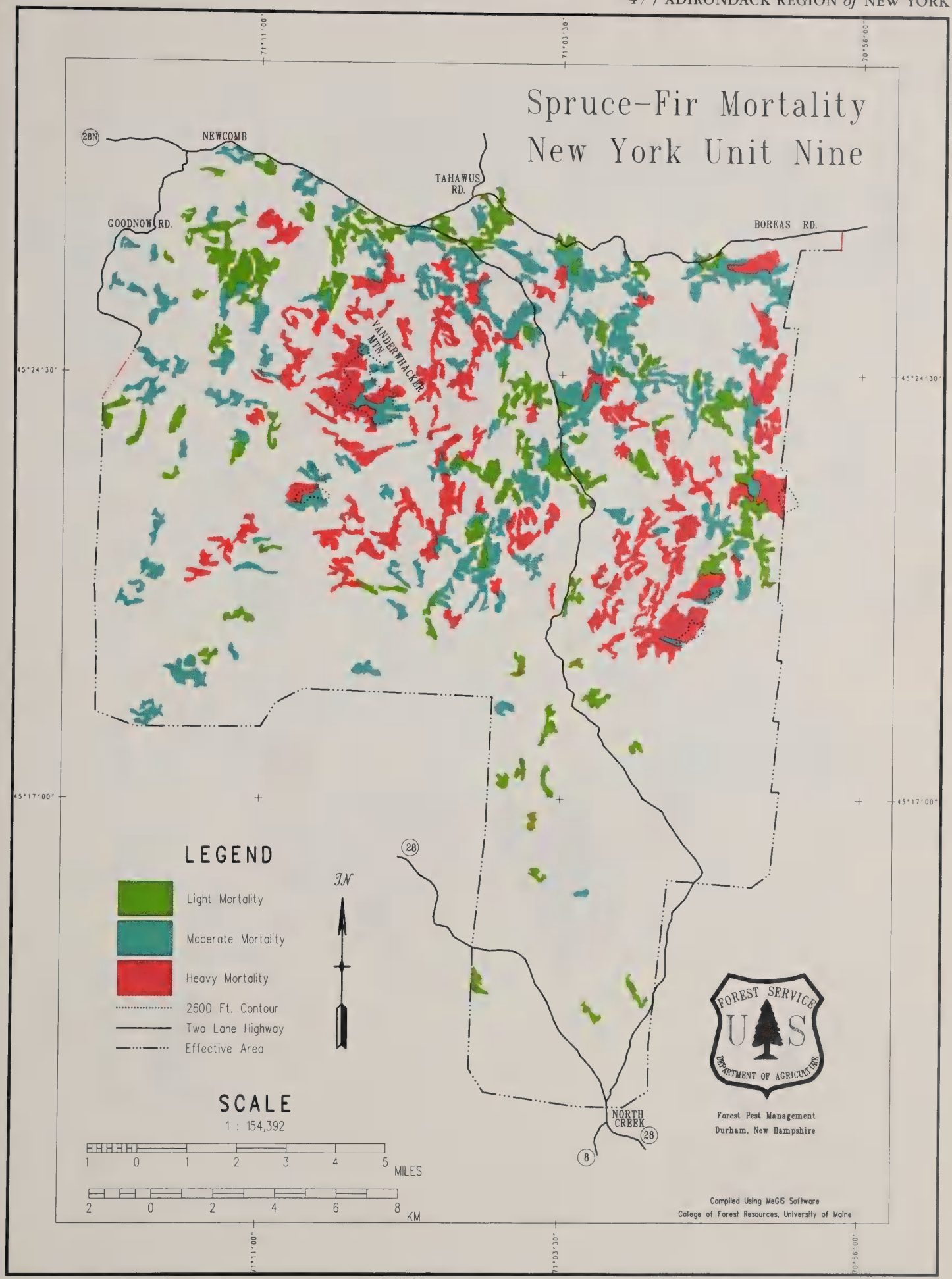

Spruce-Fir Mortality
New York Unit Nine
28N
NEWCOMB
TAHAWUS RD.
GOODNOW RD.
BOREAS RD.
VANDERWHACKER MTN
71°11'00"
71°03'30"
70°56'00"
45°24'30"
45°17'00"
LEGEND
Light Mortality
Moderate Mortality
Heavy Mortality
2600 Ft. Contour
Two Lane Highway
Effective Area
N
28
NORTH CREEK
8
SCALE
1 : 154,392
1 0 1 2 3 4 5 MILES
2 0 2 4 6 8 KM
FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE
Forest Pest Management
Durham, New Hampshire
Compiled Using MeGIS Software
College of Forest Resources, University of Maine

FIGURE NY20.

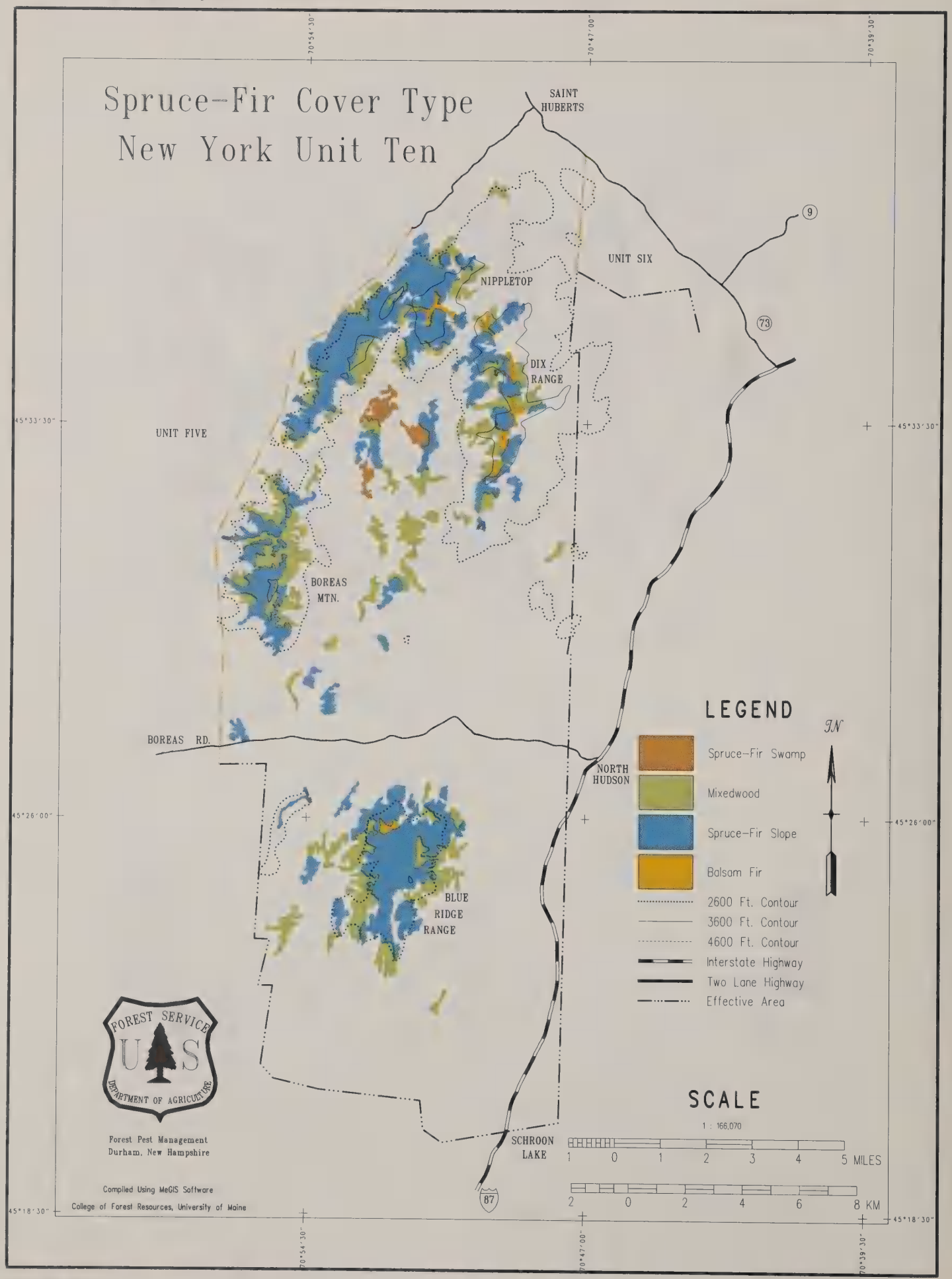

Spruce–Fir Cover Type
New York Unit Ten
SAINT HUBERTS
UNIT SIX
NIPPLETOP
DIX RANGE
UNIT FIVE
BOREAS MTN.
BOREAS RD.
NORTH HUDSON
BLUE RIDGE RANGE
SCHROON LAKE
LEGEND
Spruce–Fir Swamp
Mixedwood
Spruce–Fir Slope
Balsam Fir
2600 Ft. Contour
3600 Ft. Contour
4600 Ft. Contour
Interstate Highway
Two Lane Highway
Effective Area
SCALE
1 : 166,070
1 0 1 2 3 4 5 MILES
2 0 2 4 6 8 KM
FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE
Forest Pest Management
Durham, New Hampshire
Compiled Using MeGIS Software
College of Forest Resources, University of Maine
70°54'30"
70°47'00"
70°39'30"
45°33'30"
45°26'00"
45°18'30"

FIGURE NY21.

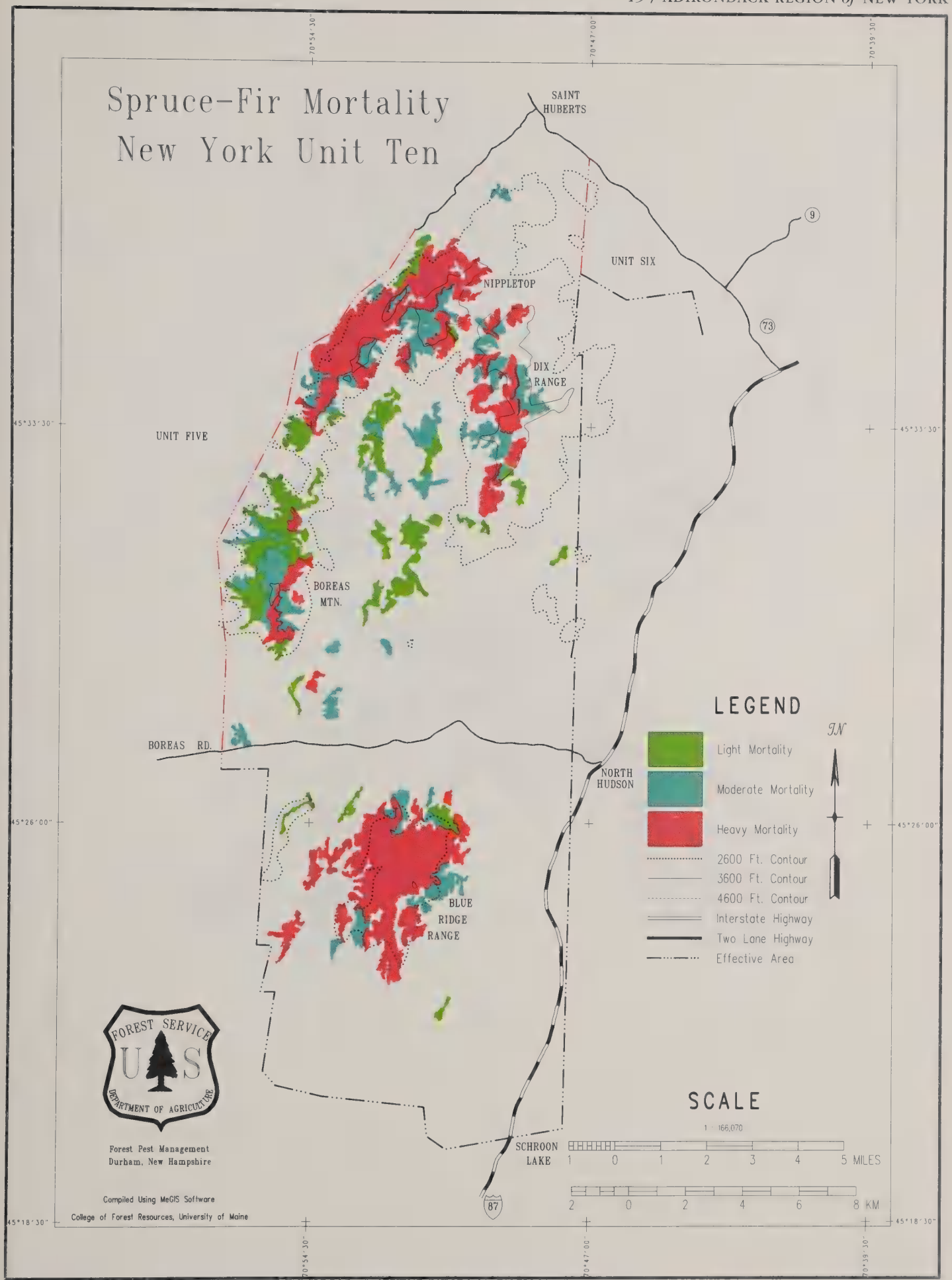

Spruce-Fir Mortality
New York Unit Ten
SAINT HUBERTS
NIPPLETOP
UNIT SIX
UNIT FIVE
DIX RANGE
BOREAS MTN.
BOREAS RD.
NORTH HUDSON
BLUE RIDGE RANGE
SCHROON LAKE
9
73
87
70°54'30"
70°47'00"
70°39'30"
45°33'30"
45°26'00"
45°18'30"
LEGEND
Light Mortality
Moderate Mortality
Heavy Mortality
2600 Ft. Contour
3600 Ft. Contour
4600 Ft. Contour
Interstate Highway
Two Lane Highway
Effective Area
N
SCALE
1 : 166,070
1 0 1 2 3 4 5 MILES
2 0 2 4 6 8 KM
FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE
Forest Pest Management
Durham, New Hampshire
Compiled Using MeGIS Software
College of Forest Resources, University of Maine

FIGURE NY22.

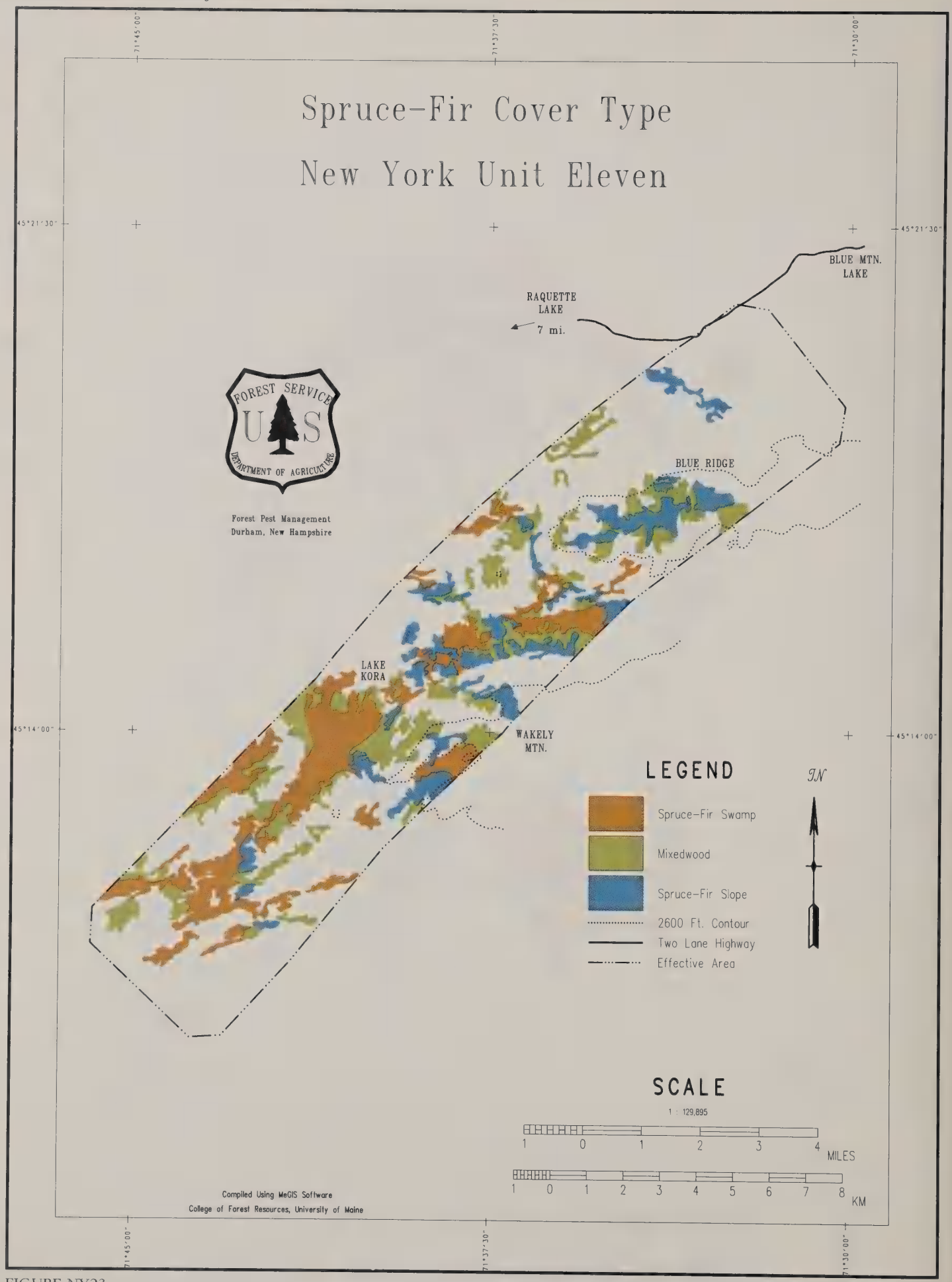

Spruce–Fir Cover Type
New York Unit Eleven
71°45'00"
71°37'30"
71°30'00"
45°21'30"
45°14'00"
BLUE MTN. LAKE
RAQUETTE LAKE
7 mi.
FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE
Forest Pest Management
Durham, New Hampshire
BLUE RIDGE
LAKE KORA
WAKELY MTN.
LEGEND
Spruce–Fir Swamp
Mixedwood
Spruce–Fir Slope
2600 Ft. Contour
Two Lane Highway
Effective Area
N
SCALE
1 : 129,895
1 0 1 2 3 4 MILES
1 0 1 2 3 4 5 6 7 8 KM
Compiled Using MeGIS Software
College of Forest Resources, University of Maine

FIGURE NY23.

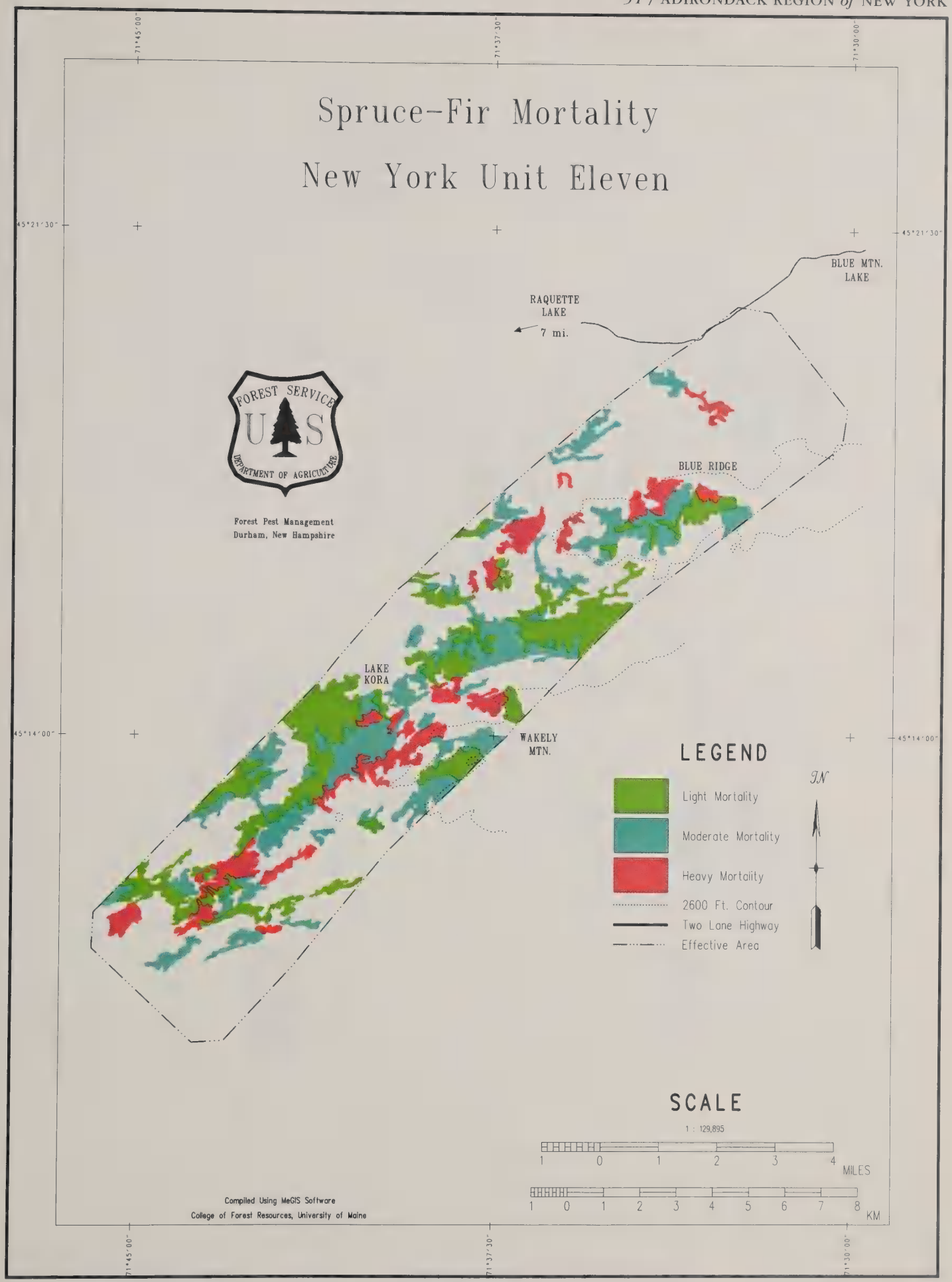

Spruce-Fir Mortality
New York Unit Eleven
71°45'00"
71°37'30"
71°30'00"
45°21'30"
45°14'00"
BLUE MTN. LAKE
RAQUETTE LAKE
7 mi.
FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE
Forest Pest Management
Durham, New Hampshire
BLUE RIDGE
LAKE KORA
WAKELY MTN.
LEGEND
Light Mortality
Moderate Mortality
Heavy Mortality
2600 Ft. Contour
Two Lane Highway
Effective Area
N
SCALE
1 : 129,895
1 0 1 2 3 4 MILES
1 0 1 2 3 4 5 6 7 8 KM
Compiled Using MeGIS Software
College of Forest Resources, University of Maine

FIGURE NY24.

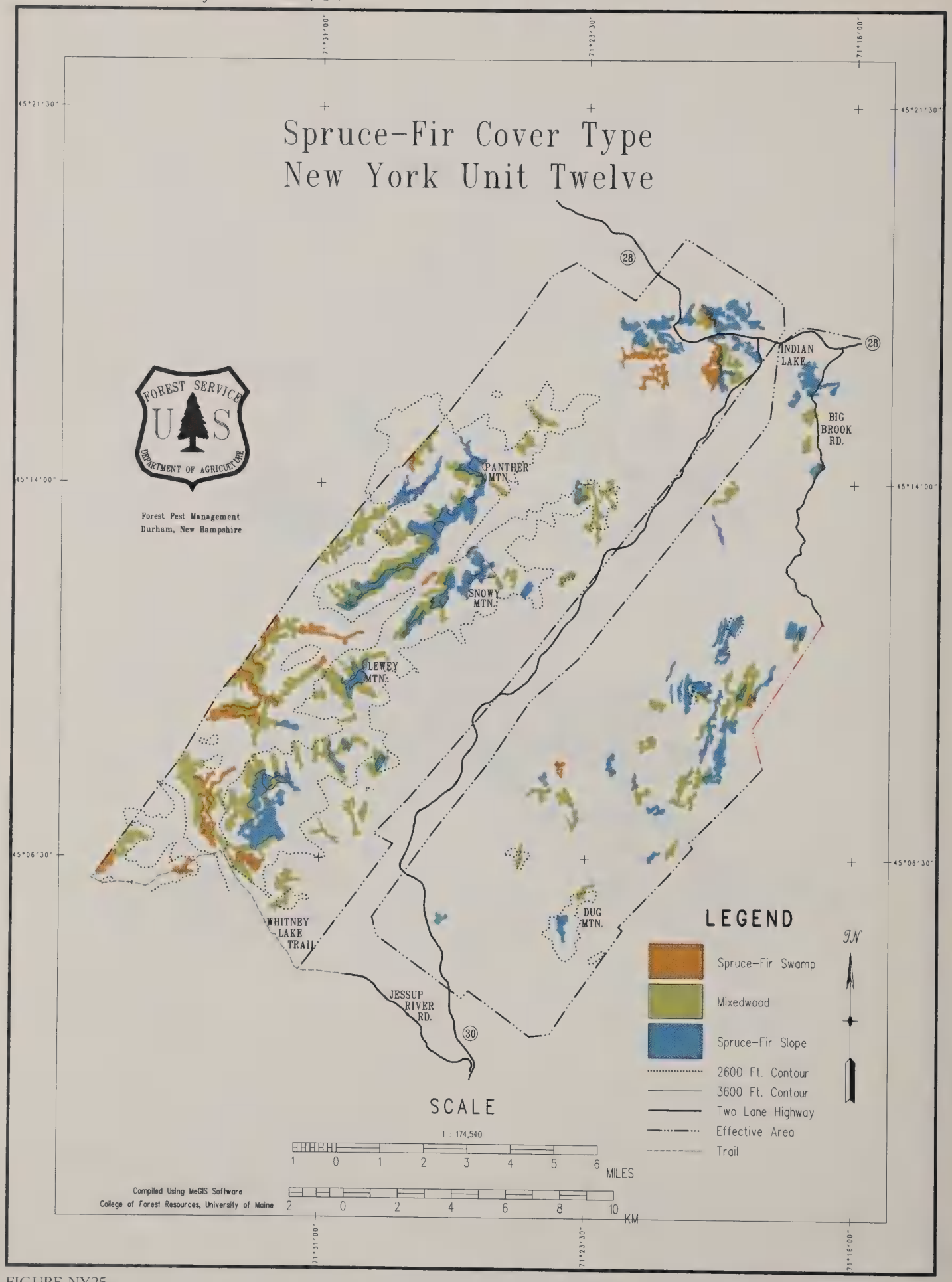

Spruce–Fir Cover Type
New York Unit Twelve
FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE
Forest Pest Management
Durham, New Hampshire
71°31'00"
71°23'30"
71°16'00"
45°21'30"
45°14'00"
45°06'30"
28
INDIAN LAKE
BIG BROOK RD.
PANTHER MTN.
SNOWY MTN.
LEWEY MTN.
DUG MTN.
WHITNEY LAKE TRAIL
JESSUP RIVER RD.
30
LEGEND
Spruce–Fir Swamp
Mixedwood
Spruce–Fir Slope
2600 Ft. Contour
3600 Ft. Contour
Two Lane Highway
Effective Area
Trail
IN
SCALE
1 : 174,540
1 0 1 2 3 4 5 6 MILES
2 0 2 4 6 8 10 KM
Compiled Using MeGIS Software
College of Forest Resources, University of Maine

FIGURE NY25.

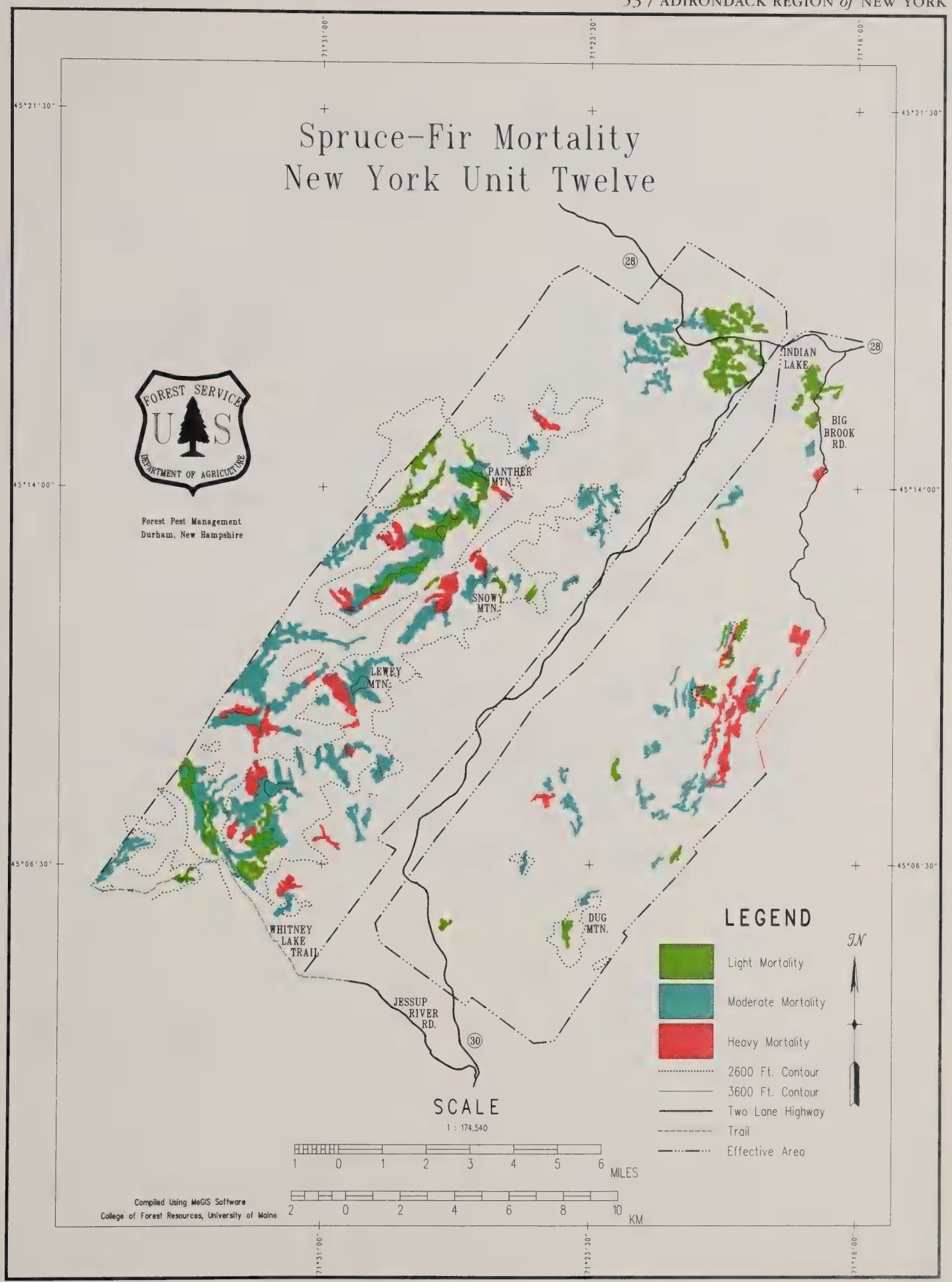

Spruce–Fir Mortality
New York Unit Twelve
71°31'00"
71°23'30"
71°16'00"
45°21'30"
45°14'00"
45°06'30"
28
30
INDIAN LAKE
BIG BROOK RD.
PANTHER MTN.
SNOWY MTN.
LEWEY MTN.
DUG MTN.
WHITNEY LAKE TRAIL
JESSUP RIVER RD.
FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE
Forest Pest Management
Durham, New Hampshire
LEGEND
Light Mortality
Moderate Mortality
Heavy Mortality
2600 Ft. Contour
3600 Ft. Contour
Two Lane Highway
Trail
Effective Area
N
SCALE
1 : 174,540
1 0 1 2 3 4 5 6 MILES
2 0 2 4 6 8 10 KM
Compiled Using MeGIS Software
College of Forest Resources, University of Maine

FIGURE NY26.

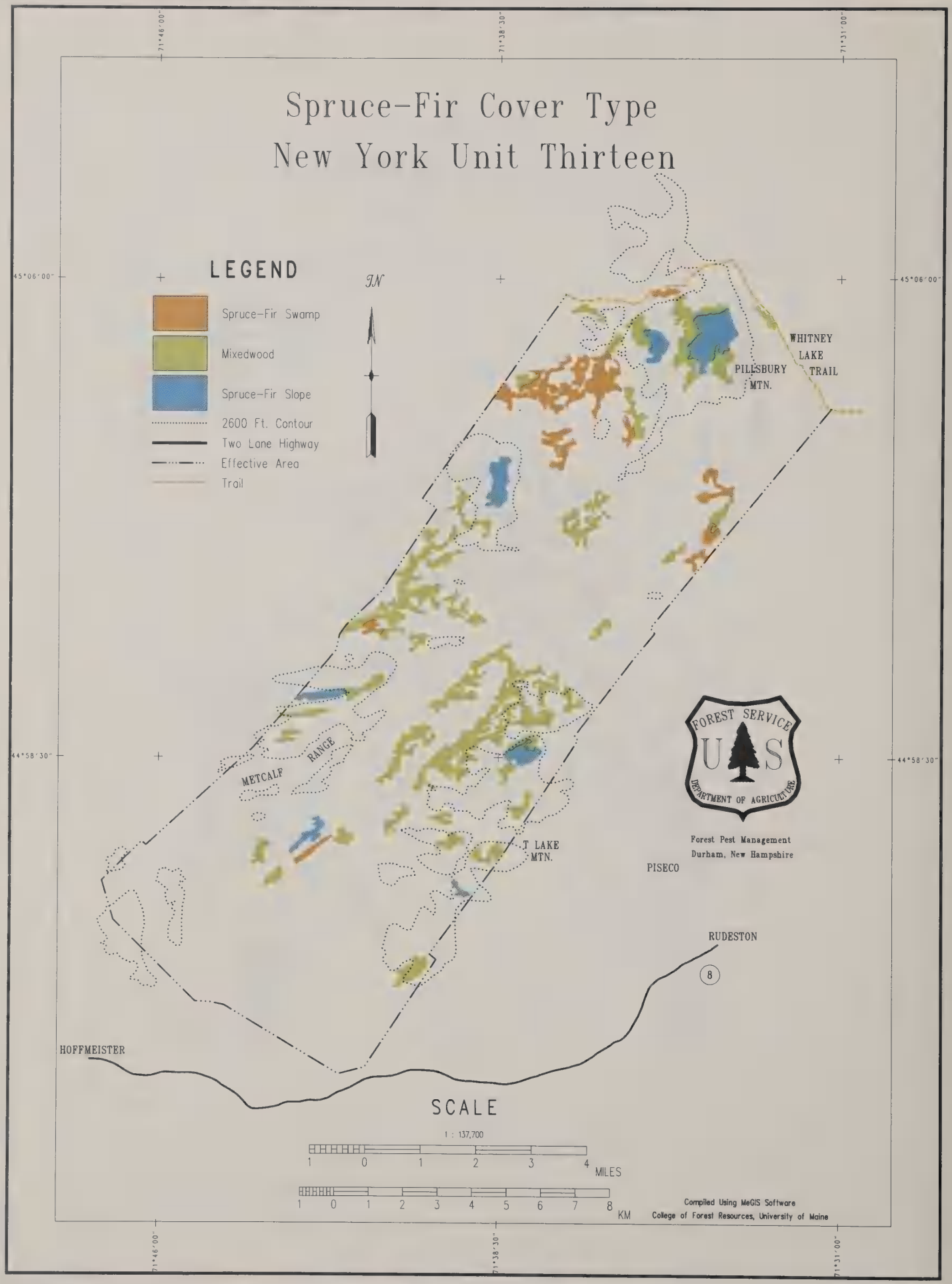

Spruce–Fir Cover Type
New York Unit Thirteen
LEGEND
Spruce–Fir Swamp
Mixedwood
Spruce–Fir Slope
2600 Ft. Contour
Two Lane Highway
Effective Area
Trail
N
WHITNEY
LAKE
TRAIL
PILLSBURY
MTN.
METCALF
RANGE
T LAKE
MTN.
PISECO
RUDESTON
8
HOFFMEISTER
FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE
Forest Pest Management
Durham, New Hampshire
SCALE
1 : 137,700
1 0 1 2 3 4 MILES
1 0 1 2 3 4 5 6 7 8 KM
Compiled Using MeGIS Software
College of Forest Resources, University of Maine
71°46'00"
71°38'30"
71°31'00"
45°06'00"
44°58'30"

FIGURE NY27.

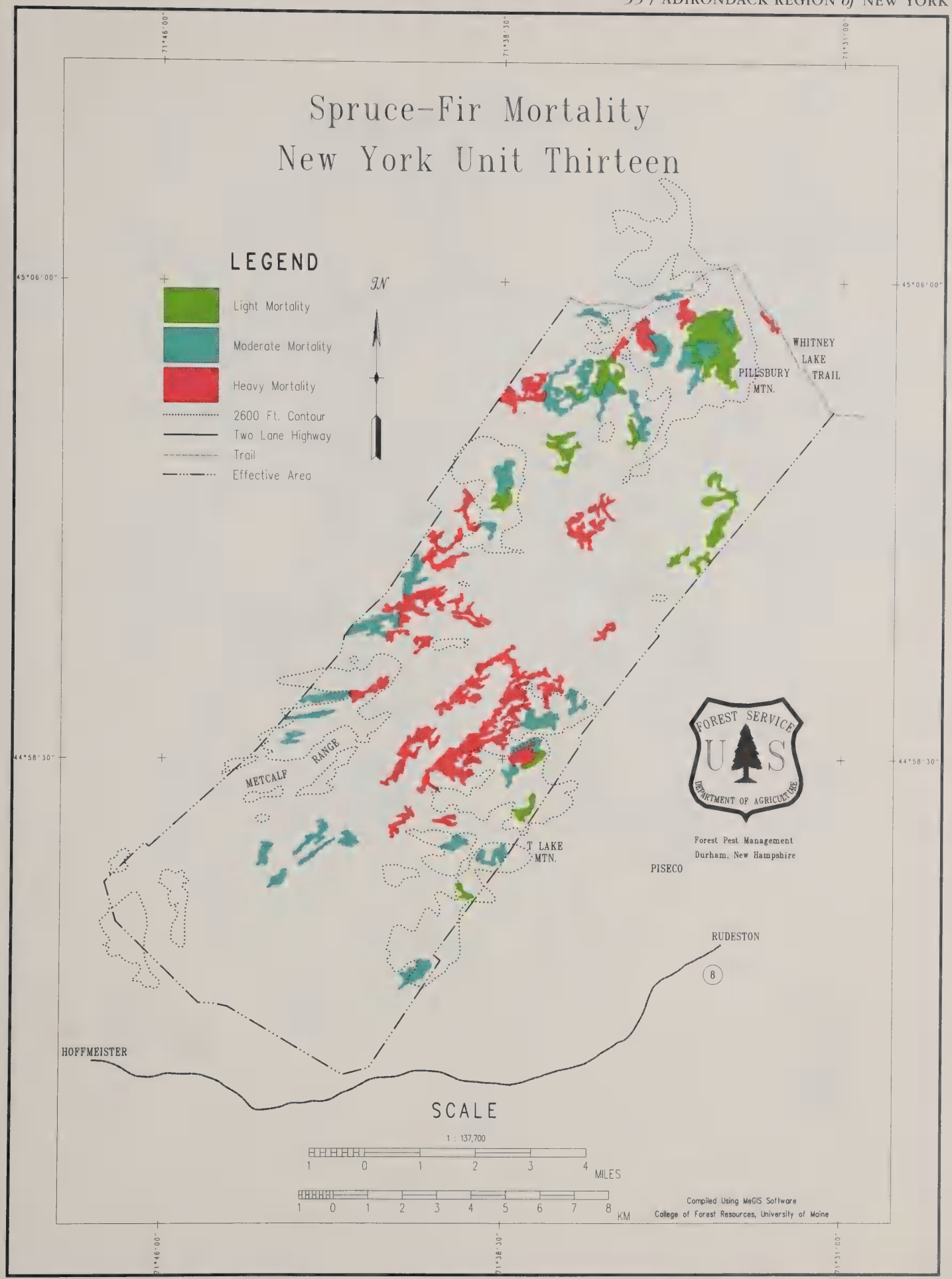

Spruce-Fir Mortality
New York Unit Thirteen
LEGEND
Light Mortality
Moderate Mortality
Heavy Mortality
2600 Ft. Contour
Two Lane Highway
Trail
Effective Area
N
71°46'00"
71°38'30"
71°31'00"
45°06'00"
44°58'30"
WHITNEY
LAKE
TRAIL
PILLSBURY
MTN.
METCALF
RANGE
T LAKE
MTN.
PISECO
RUDESTON
8
HOFFMEISTER
FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE
Forest Pest Management
Durham, New Hampshire
SCALE
1 : 137,700
1 0 1 2 3 4 MILES
1 0 1 2 3 4 5 6 7 8 KM
Compiled Using MeGIS Software
College of Forest Resources, University of Maine

FIGURE NY28.

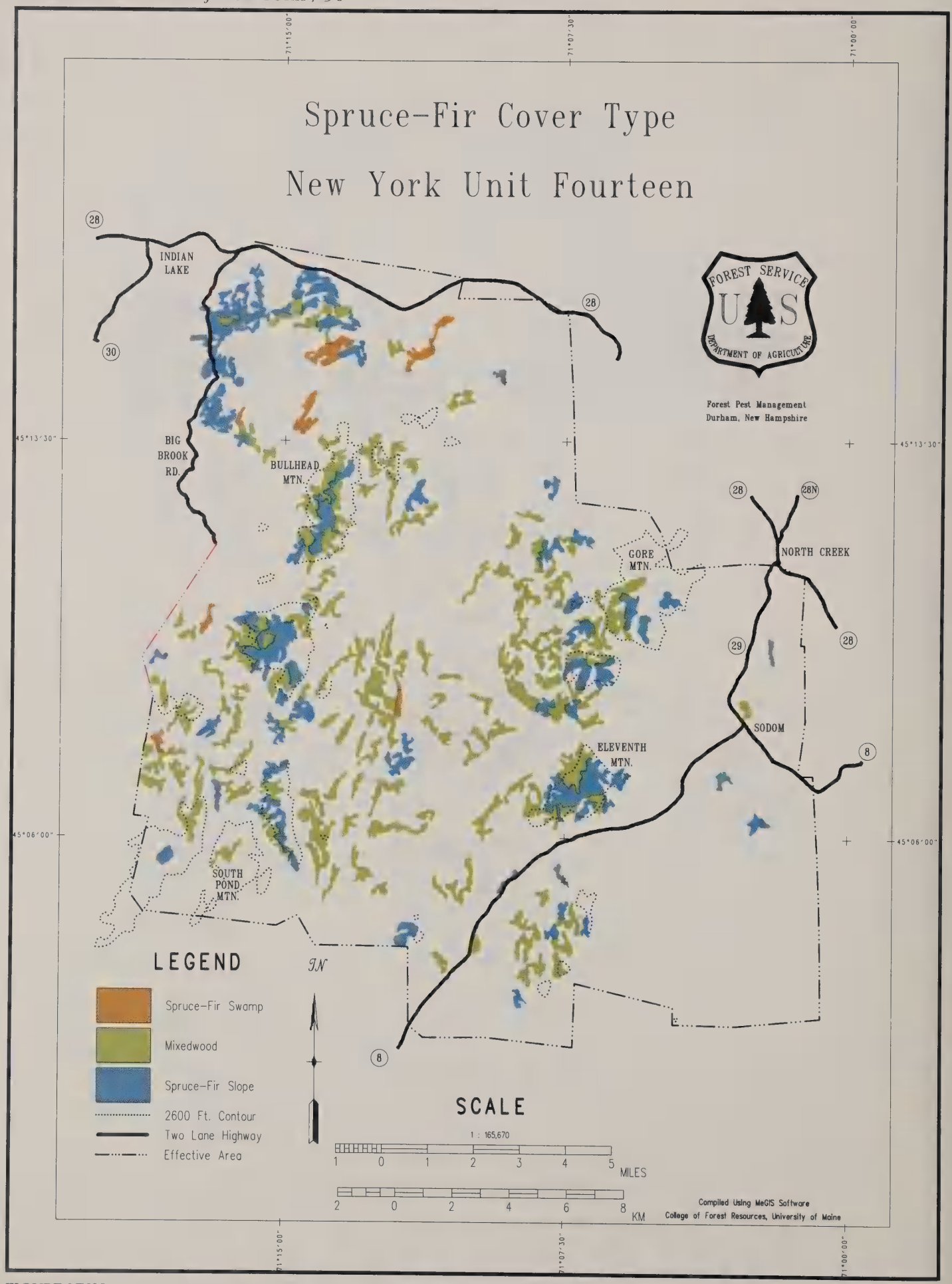

Spruce-Fir Cover Type
New York Unit Fourteen
INDIAN LAKE
BIG BROOK RD.
BULLHEAD MTN.
GORE MTN.
NORTH CREEK
SODOM
ELEVENTH MTN.
SOUTH POND MTN.
28
28N
30
29
8
FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE
Forest Pest Management
Durham, New Hampshire
71°15'00"
71°07'30"
71°00'00"
45°13'30"
45°06'00"
LEGEND
Spruce-Fir Swamp
Mixedwood
Spruce-Fir Slope
2600 Ft. Contour
Two Lane Highway
Effective Area
IN
SCALE
1 : 165,670
1 0 1 2 3 4 5 MILES
2 0 2 4 6 8 KM
Compiled Using MeGIS Software
College of Forest Resources, University of Maine

FIGURE NY29.

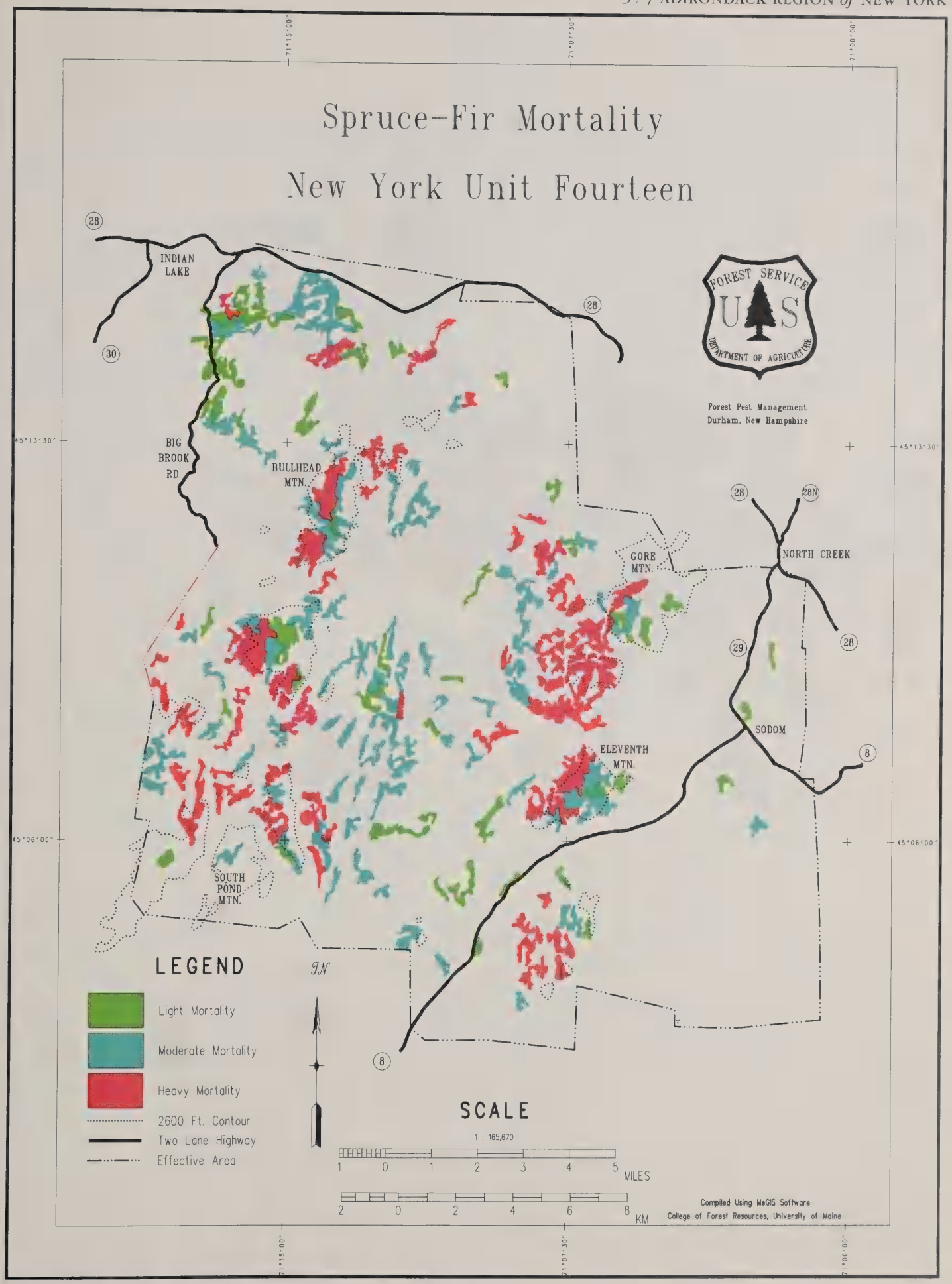
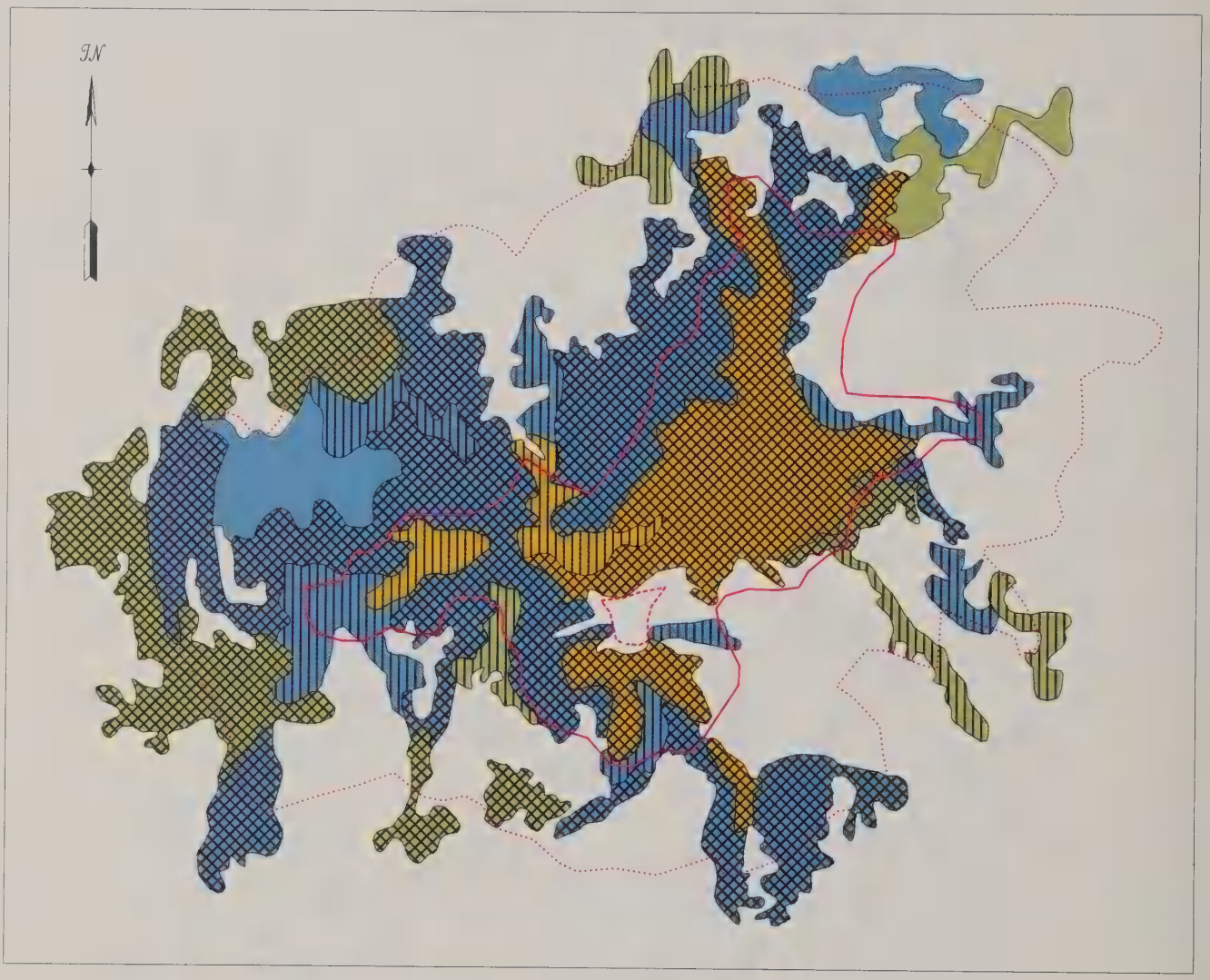

Spruce-Fir Mortality
New York Unit Fourteen
INDIAN LAKE
BIG BROOK RD.
BULLHEAD MTN.
GORE MTN.
NORTH CREEK
SODOM
ELEVENTH MTN.
SOUTH POND MTN.
28
28N
30
29
8
71°15'00"
71°07'30"
71°00'00"
45°13'30"
45°06'00"
FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE
Forest Pest Management
Durham, New Hampshire
LEGEND
Light Mortality
Moderate Mortality
Heavy Mortality
2600 Ft. Contour
Two Lane Highway
Effective Area
N
SCALE
1 : 165,670
1 0 1 2 3 4 5 MILES
2 0 2 4 6 8 KM
Compiled Using MeGIS Software
College of Forest Resources, University of Maine

FIGURE NY30.

Analysis of Mortality in Spruce-Fir On Whiteface Mountain Wilmington, NY



Distribution of Decline Within Types

COVERTYPE	MORTALITY CLASS					
	LIGHT		MODERATE		HEAVY	
	ACRES	10%	ACRES	% of TYPE	ACRES	% of TYPE
Mixedwood	99.02	10%	221.43	22%	667.93	68%
Spruce-Fir Slope	273.75	11%	474.61	19%	1721.99	70%
Balsam Fir	0	0%	137.36	15%	773.19	85%
Total	372.77	8.5%	833.40	19.1%	3163.11	72.4%

		90%	
		89%	
		100%	

LEGEND

- Mixedwood
- Spruce-Fir Slope
- Balsam Fir
- Light Mortality
- Moderate Mortality
- Heavy Mortality
- Covertype Boundary
- 2600 Ft. Contour
- 3600 Ft. Contour
- 4600 Ft. Contour

SCALE

1 : 45,412

3000 0 3000 6000 FEET

500 0 500 1000 1500 2000 METERS

FIGURE NY31.

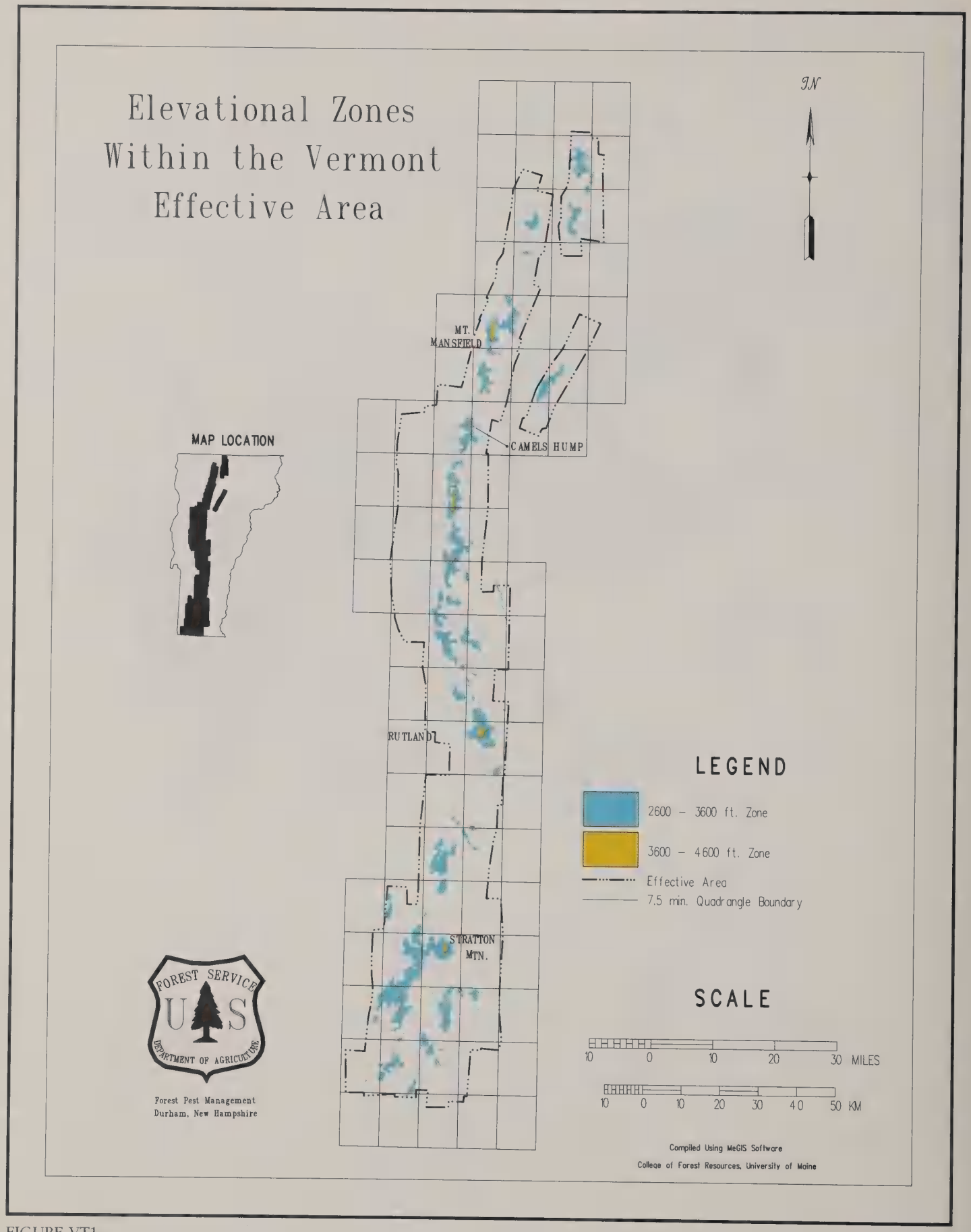

Elevational Zones
Within the Vermont
Effective Area
N
MT.
MANSFIELD
CAMELS HUMP
MAP LOCATION
RUTLAND
STRATTON
MTN.
LEGEND
2600 – 3600 ft. Zone
3600 – 4600 ft. Zone
Effective Area
7.5 min. Quadrangle Boundary
SCALE
10 0 10 20 30 MILES
10 0 10 20 30 40 50 KM
FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE
Forest Pest Management
Durham, New Hampshire
Compiled Using MeGIS Software
College of Forest Resources, University of Maine

FIGURE VT1.

GREEN MOUNTAINS *of* VERMONT

Although the Green Mountains are part of the Appalachian chain, their physiographic form differentiates the Vermont region from the adjacent White Mountains. The Green Mountains are elongated, parallel ridges, lying in a north-south pattern spanning the entire state. To the east, they drop to the Central Plateau of the New England Upland and the Connecticut River Valley. The mountains are bounded on the west by the Champlain Valley in the northern part of the state, and the Vermont Valley and Taconic Mountains in the southern part of the state. Several peaks are above 3,600 ft; the tallest, Mount Mansfield (4,451 ft), is in northern Vermont.

The Green Mountain National Forest, created in 1932, encompasses approximately 325,400 acres. Mount Ellen (4,135 ft) is the tallest mountain in the Green Mountain National Forest. Most of the slopes below 3,000 ft have been logged or cleared for agriculture. After the rocky hillside farms failed, some areas were used as sheep pastures, which severely degraded the soils. Many of the areas above 3,000 ft have not been cut or have been cut only once. Spruce-fir forests are primarily on the upper slopes. In southern Vermont, these forests merge with deciduous forests at higher elevations than in the northern part of the state due to the upslope advance of hardwoods. Spruce-fir forests also occupy many old-field and swamp sites in the lower elevations surrounding the Green Mountains.

The largest area photographed for this survey was in Vermont (1.4 million acres). The area spans a greater latitude than the other regions. Vermont, however, had the smallest acreage of spruce-fir forest. Figure VT1 illustrates the elevations in the photographed area of Vermont. Figure VT2 shows the distribution of mortality (standing dead) by cover type and Figure VT3 shows the distribution by elevation. A large portion of the photographed area was in the outlying lower elevations. Unlike the other

largest spruce-fir cover type in Vermont. The mixedwood represented over one-half of the mapped spruce-fir area in Vermont, while spruce-fir slope made up about one-third.

Approximately one-half of the mixedwood and spruce-fir slope was below 2,600 ft. Much of the low-elevation, mixedwood cover was on old farmland where weak competition from hardwoods on poor soils allowed red and white spruce and balsam fir to become established, provided there was a seed source. These stands probably became established slowly while being pastured. Hardwood regeneration may have been suppressed while spruce and fir seeded in from farm woodlots or uncut wet areas. Most of the remainder of the mixedwood and spruce-fir slope was at the mid-elevations (2,600-to-3,600 ft) along the ridges. There was very little mixed-wood or spruce-fir slope above 3600 ft due to the small land area at the higher elevations.

Only a small portion of the mixedwood and spruce-fir slope was rated in the heavy mortality class. Over half of the total spruce-fir slope and two-thirds of the mixedwood had light mortality. Below 2,600 ft, mortality was mostly light within all spruce-fir cover types in Vermont. However, above 2,600 ft most of the spruce-fir slope had moderate mortality.

About half of Vermont's balsam fir type was in the 2,600-to-3,600 ft zone and the remainder was almost evenly divided between the higher and lower elevations. The proportion of mortality in balsam fir increased with increased elevation. Vermont had the lowest incidence of fir waves, which occurred in an estimated 11 percent of the area with heavy mortality and 3 percent of the moderate mortality area. The smallest area was in spruce-fir swamp and most of that was in the light mortality class.

Figure VT4 is an index of the five mapping units in Vermont. Figures VT5-VT14 display the cover types and mortality in each unit. ❧

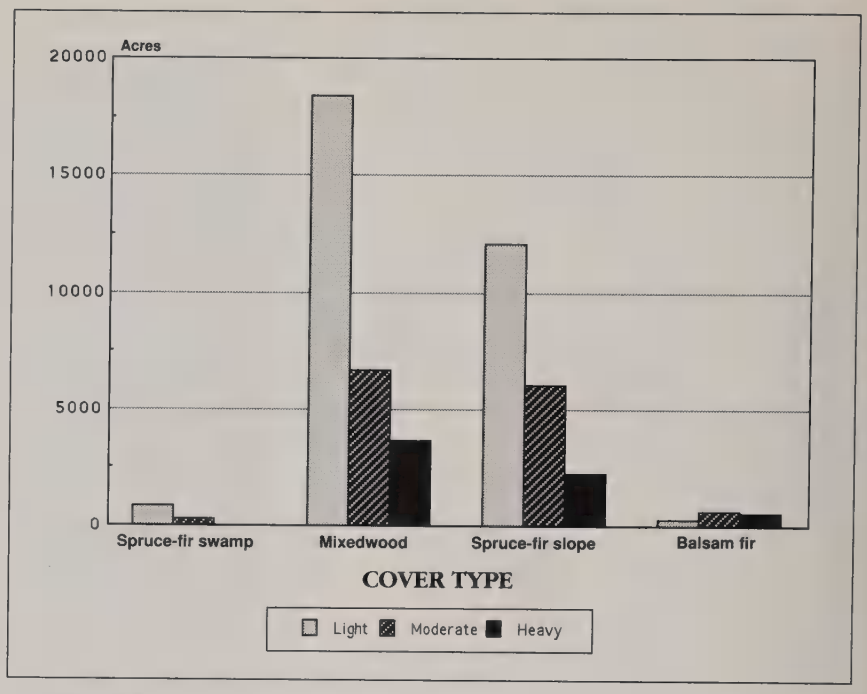


FIGURE VT2.
Distribution of mortality (standing dead) by cover type in the Green Mountains of Vermont.

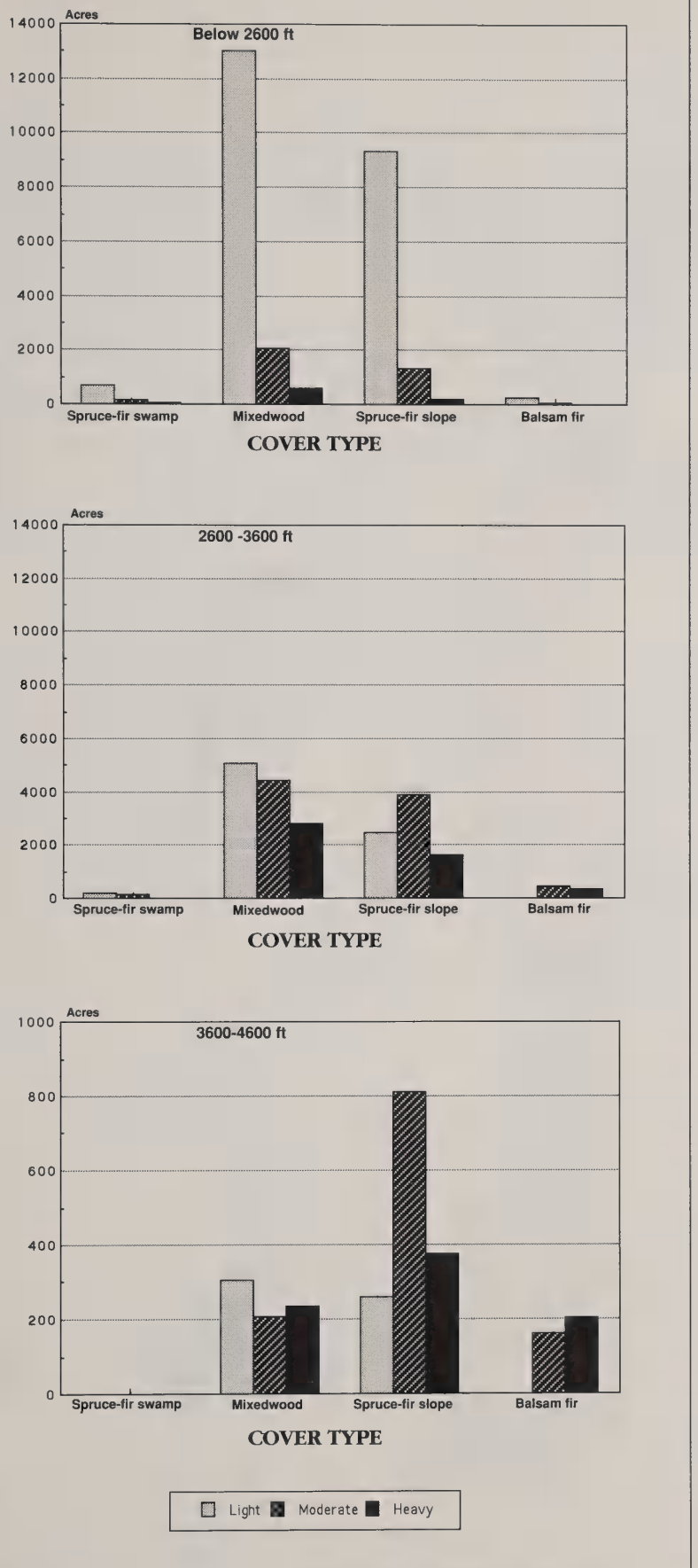


FIGURE VT3.
Distribution of mortality (standing dead) by cover type and elevation in the Green Mountains of Vermont.

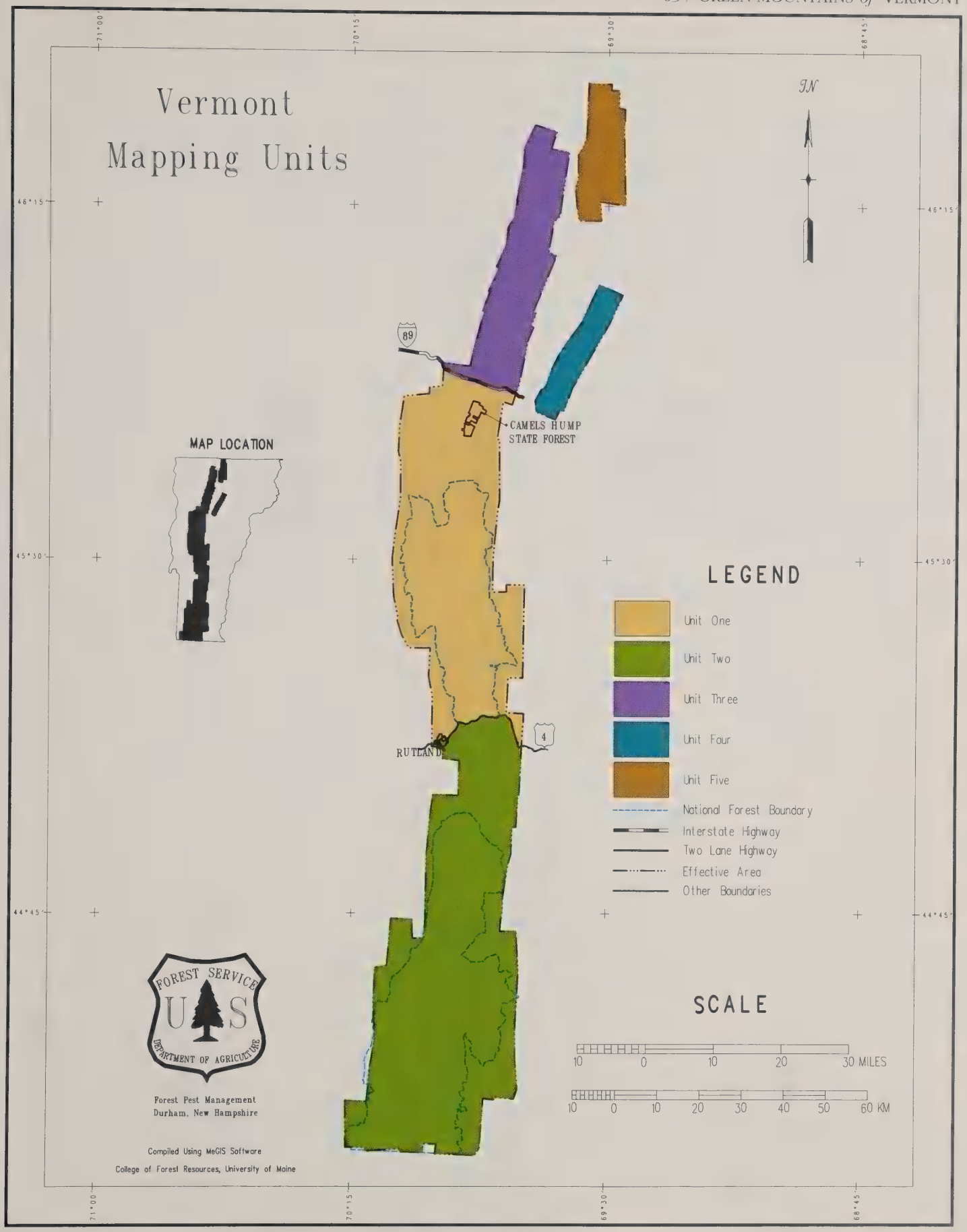

Vermont
Mapping Units
71°00'
70°15'
69°30'
68°45'
46°15'
45°30'
44°45'
IN
89
CAMELS HUMP
STATE FOREST
RUTLAND
4
MAP LOCATION
LEGEND
Unit One
Unit Two
Unit Three
Unit Four
Unit Five
National Forest Boundary
Interstate Highway
Two Lane Highway
Effective Area
Other Boundaries
SCALE
10 0 10 20 30 MILES
10 0 10 20 30 40 50 60 KM
FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE
Forest Pest Management
Durham, New Hampshire
Compiled Using MeGIS Software
College of Forest Resources, University of Maine

FIGURE VT4.

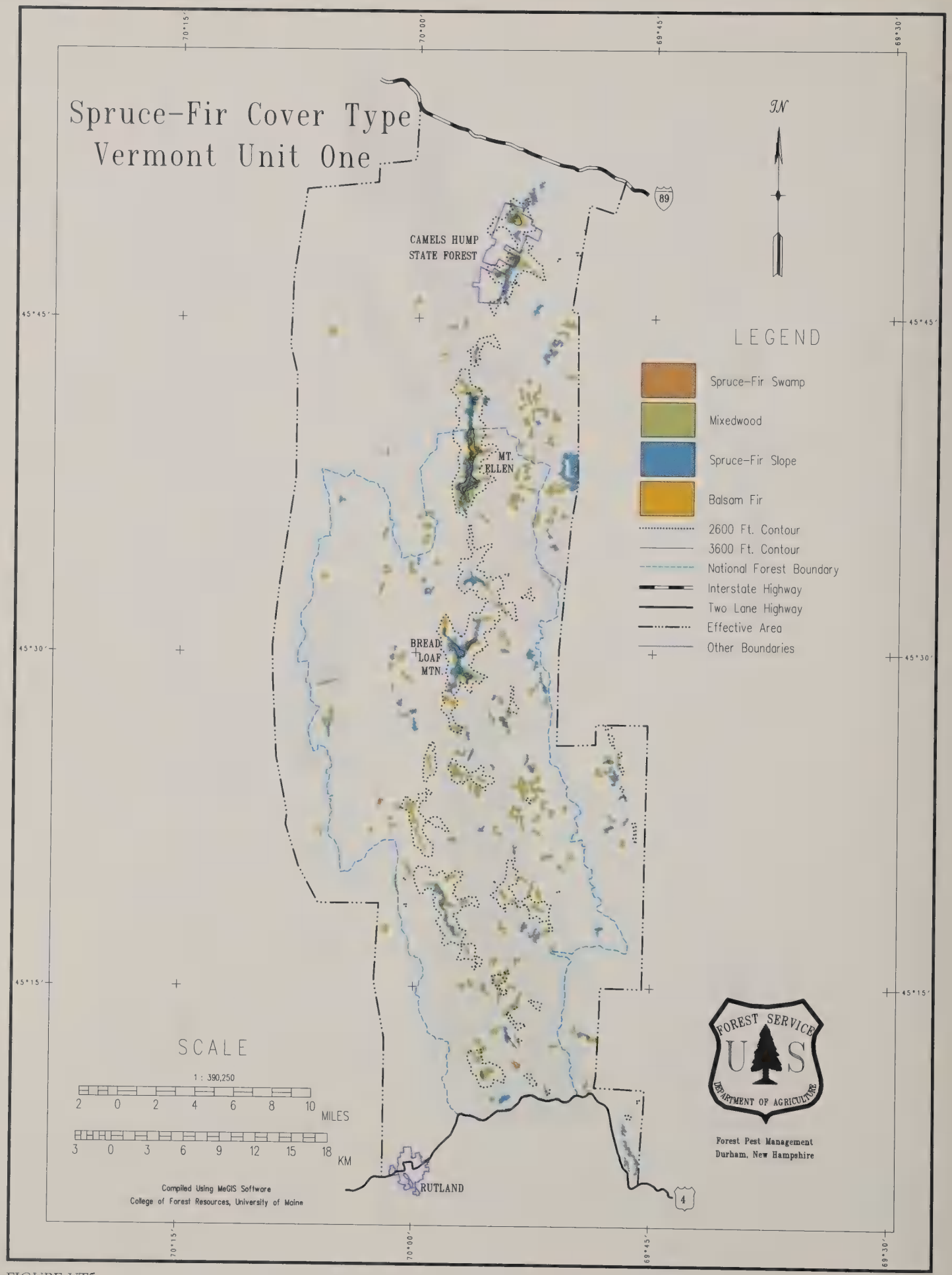

Spruce-Fir Cover Type
Vermont Unit One
IN
89
CAMELS HUMP
STATE FOREST
MT.
ELLEN
BREAD
LOAF
MTN.
RUTLAND
4
LEGEND
Spruce-Fir Swamp
Mixedwood
Spruce-Fir Slope
Balsam Fir
2600 Ft. Contour
3600 Ft. Contour
National Forest Boundary
Interstate Highway
Two Lane Highway
Effective Area
Other Boundaries
SCALE
1 : 390,250
2 0 2 4 6 8 10 MILES
3 0 3 6 9 12 15 18 KM
Compiled Using MeGIS Software
College of Forest Resources, University of Maine
FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE
Forest Pest Management
Durham, New Hampshire
70°15'
70°00'
69°45'
69°30'
45°45'
45°30'
45°15'

FIGURE VT5.

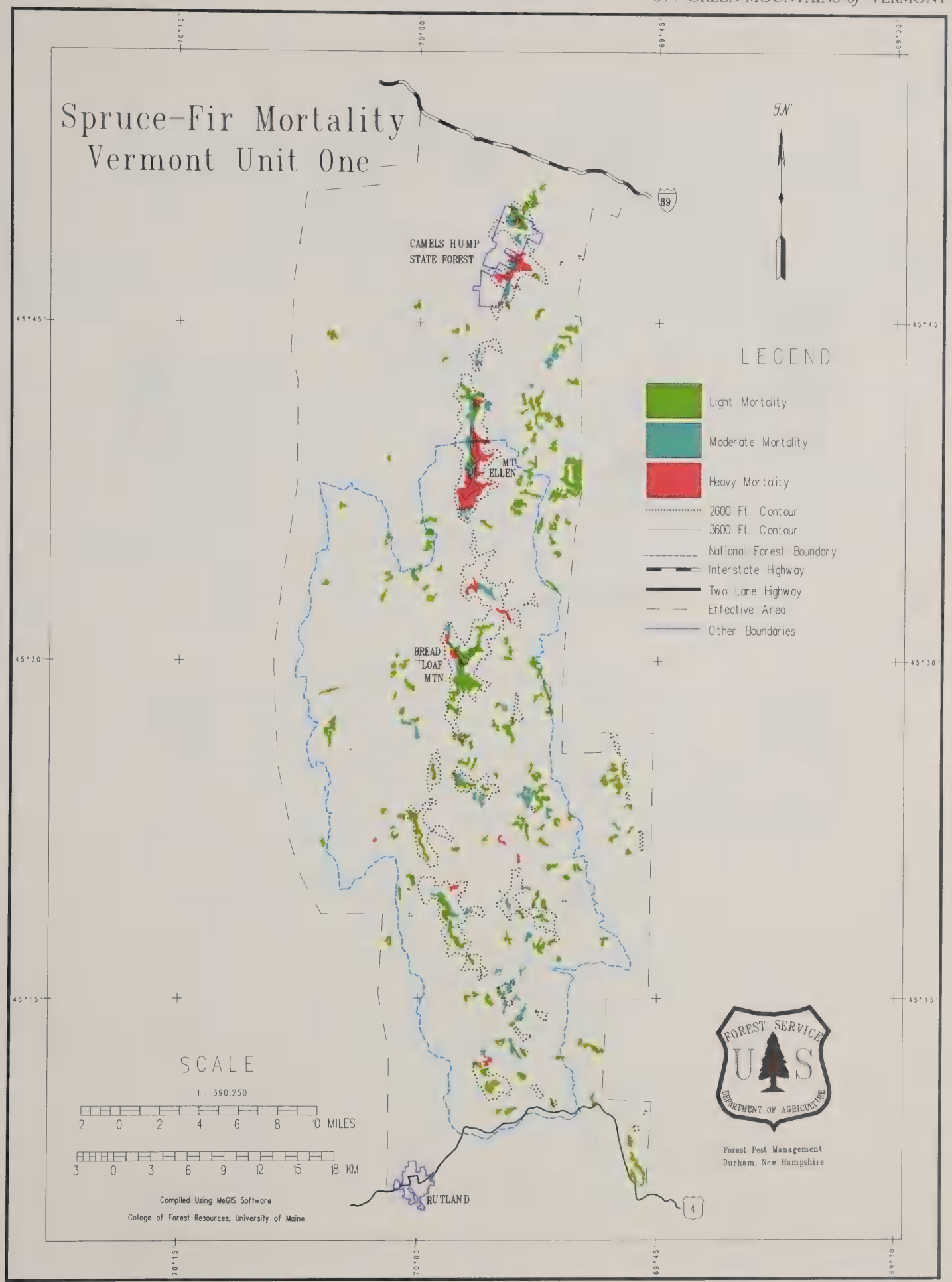

Spruce-Fir Mortality
Vermont Unit One
CAMELS HUMP
STATE FOREST
MT.
ELLEN
BREAD
LOAF
MTN.
RUTLAND
89
4
70°15'
70°00'
69°45'
69°30'
45°45'
45°30'
45°15'
N
LEGEND
Light Mortality
Moderate Mortality
Heavy Mortality
2600 Ft. Contour
3600 Ft. Contour
National Forest Boundary
Interstate Highway
Two Lane Highway
Effective Area
Other Boundaries
SCALE
1 : 390,250
2 0 2 4 6 8 10 MILES
3 0 3 6 9 12 15 18 KM
Compiled Using MeGIS Software
College of Forest Resources, University of Maine
FOREST SERVICE
US
DEPARTMENT OF AGRICULTURE
Forest Pest Management
Durham, New Hampshire

FIGURE VT6.

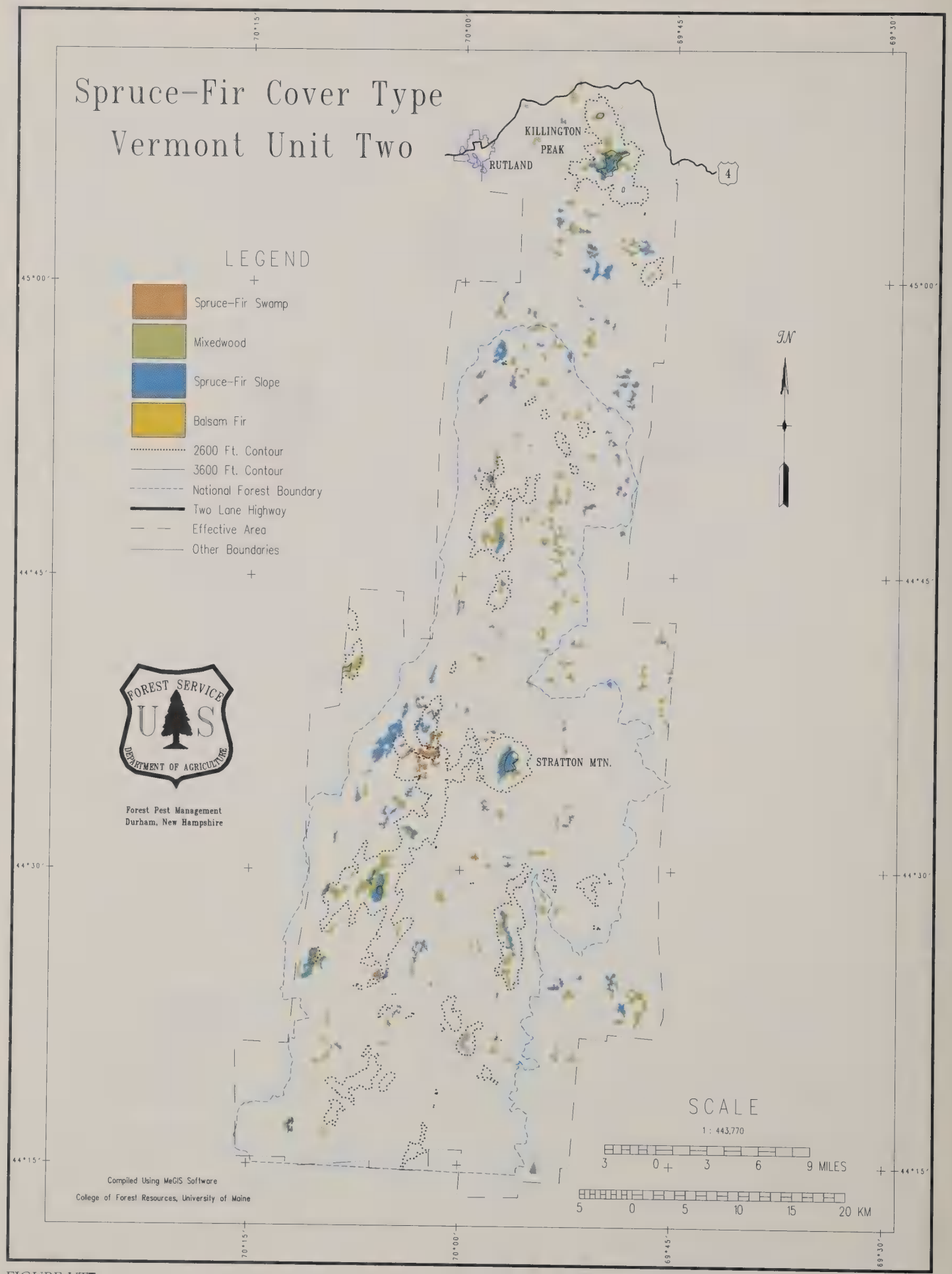

Spruce–Fir Cover Type
Vermont Unit Two
KILLINGTON
PEAK
RUTLAND
4
LEGEND
Spruce–Fir Swamp
Mixedwood
Spruce–Fir Slope
Balsam Fir
2600 Ft. Contour
3600 Ft. Contour
National Forest Boundary
Two Lane Highway
Effective Area
Other Boundaries
FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE
Forest Pest Management
Durham, New Hampshire
STRATTON MTN.
SCALE
1 : 443,770
3 0 3 6 9 MILES
5 0 5 10 15 20 KM
Compiled Using MeGIS Software
College of Forest Resources, University of Maine
70°15'
70°00'
69°45'
69°30'
45°00'
44°45'
44°30'
44°15'

FIGURE VT7.

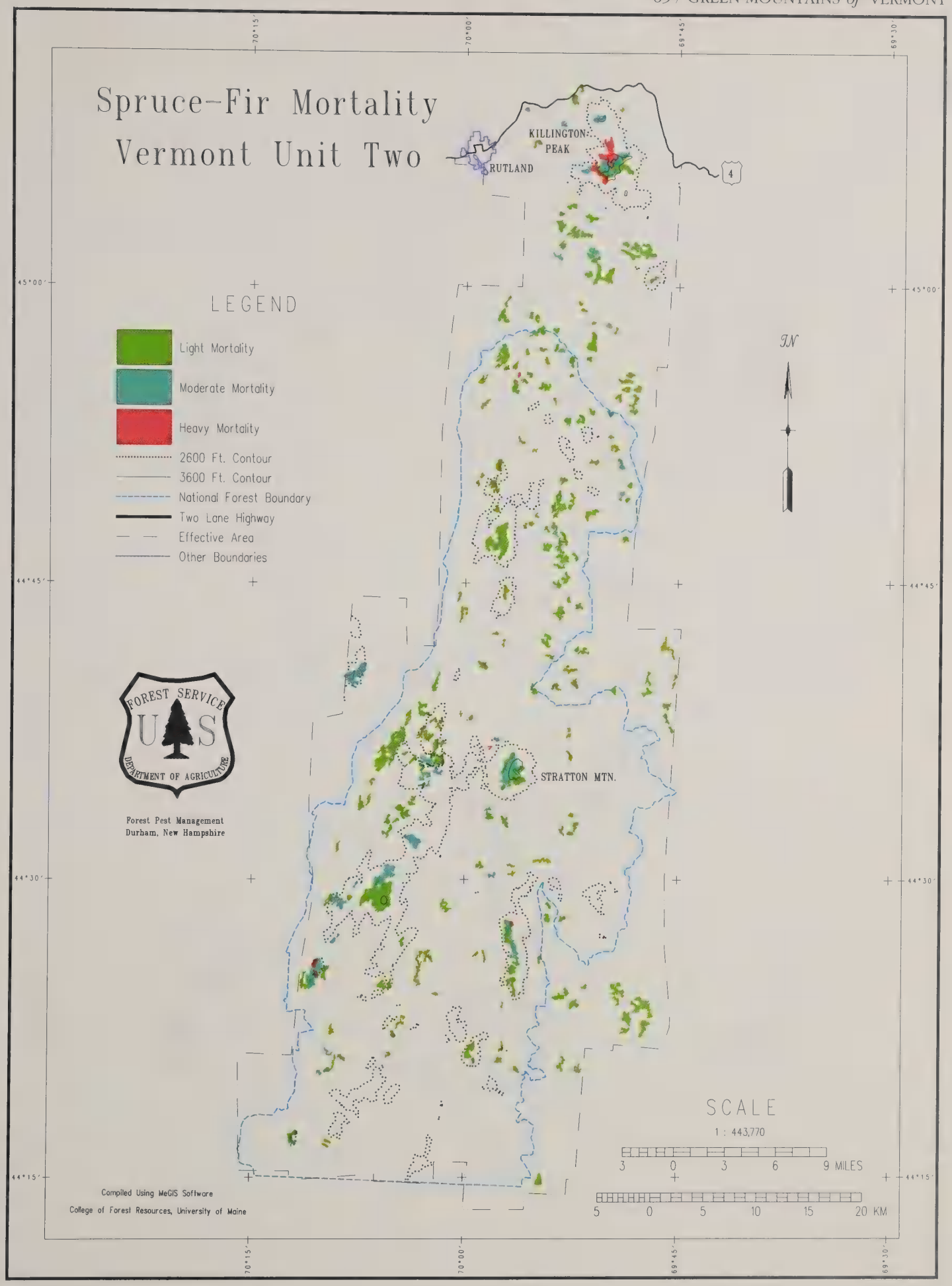

Spruce-Fir Mortality
Vermont Unit Two
KILLINGTON PEAK
RUTLAND
4
LEGEND
Light Mortality
Moderate Mortality
Heavy Mortality
2600 Ft. Contour
3600 Ft. Contour
National Forest Boundary
Two Lane Highway
Effective Area
Other Boundaries
FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE
Forest Pest Management
Durham, New Hampshire
STRATTON MTN.
IN
SCALE
1 : 443,770
3 0 3 6 9 MILES
5 0 5 10 15 20 KM
Compiled Using MeGIS Software
College of Forest Resources, University of Maine
70°15'
70°00'
69°45'
69°30'
45°00'
44°45'
44°30'
44°15'

FIGURE VT8.

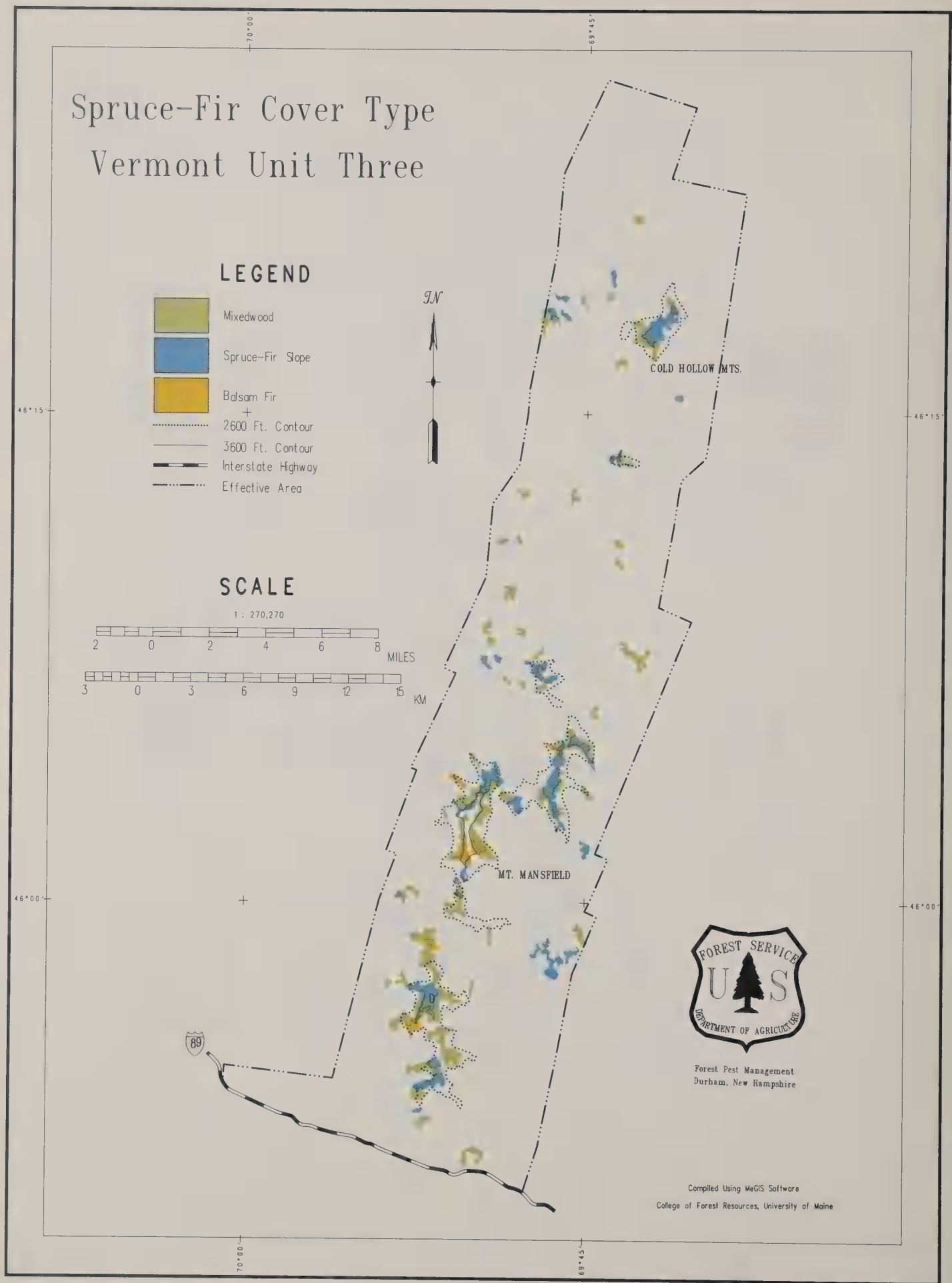

Spruce-Fir Cover Type
Vermont Unit Three
LEGEND
Mixedwood
Spruce-Fir Slope
Balsam Fir
2600 Ft. Contour
3600 Ft. Contour
Interstate Highway
Effective Area
SCALE
1 : 270,270
2 0 2 4 6 8 MILES
3 0 3 6 9 12 15 KM
IN
COLD HOLLOW MTS.
MT. MANSFIELD
89
70°00'
69°45'
46°15'
46°00'
FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE
Forest Pest Management
Durham, New Hampshire
Compiled Using MeGIS Software
College of Forest Resources, University of Maine

FIGURE VT9.

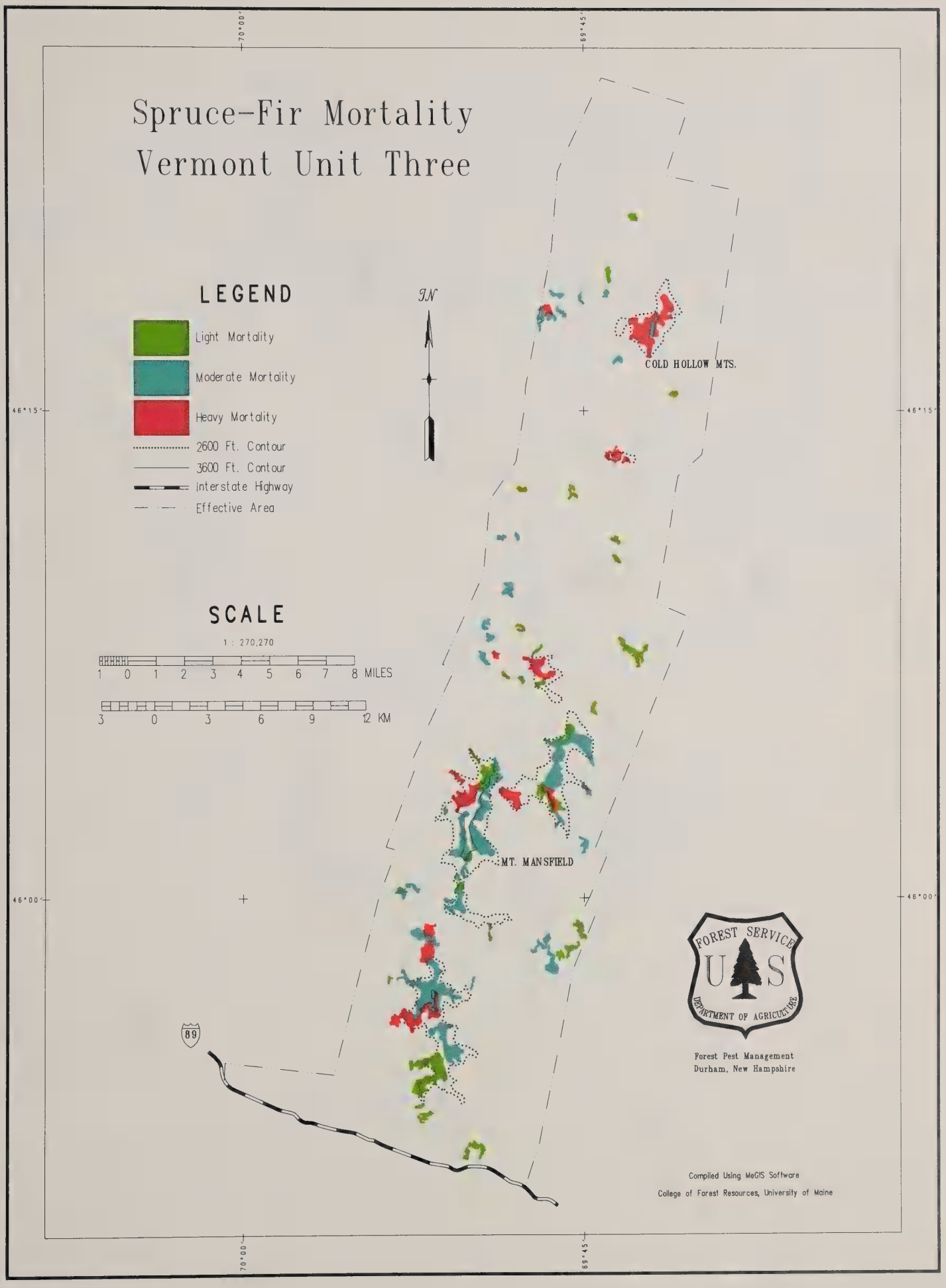

Spruce-Fir Mortality
Vermont Unit Three
LEGEND
Light Mortality
Moderate Mortality
Heavy Mortality
2600 Ft. Contour
3600 Ft. Contour
Interstate Highway
Effective Area
SCALE
1 : 270,270
1 0 1 2 3 4 5 6 7 8 MILES
3 0 3 6 9 12 KM
N
COLD HOLLOW MTS.
MT. MANSFIELD
89
70°00'
69°45'
46°15'
46°00'
FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE
Forest Pest Management
Durham, New Hampshire
Compiled Using MaGIS Software
College of Forest Resources, University of Maine

FIGURE VT10.

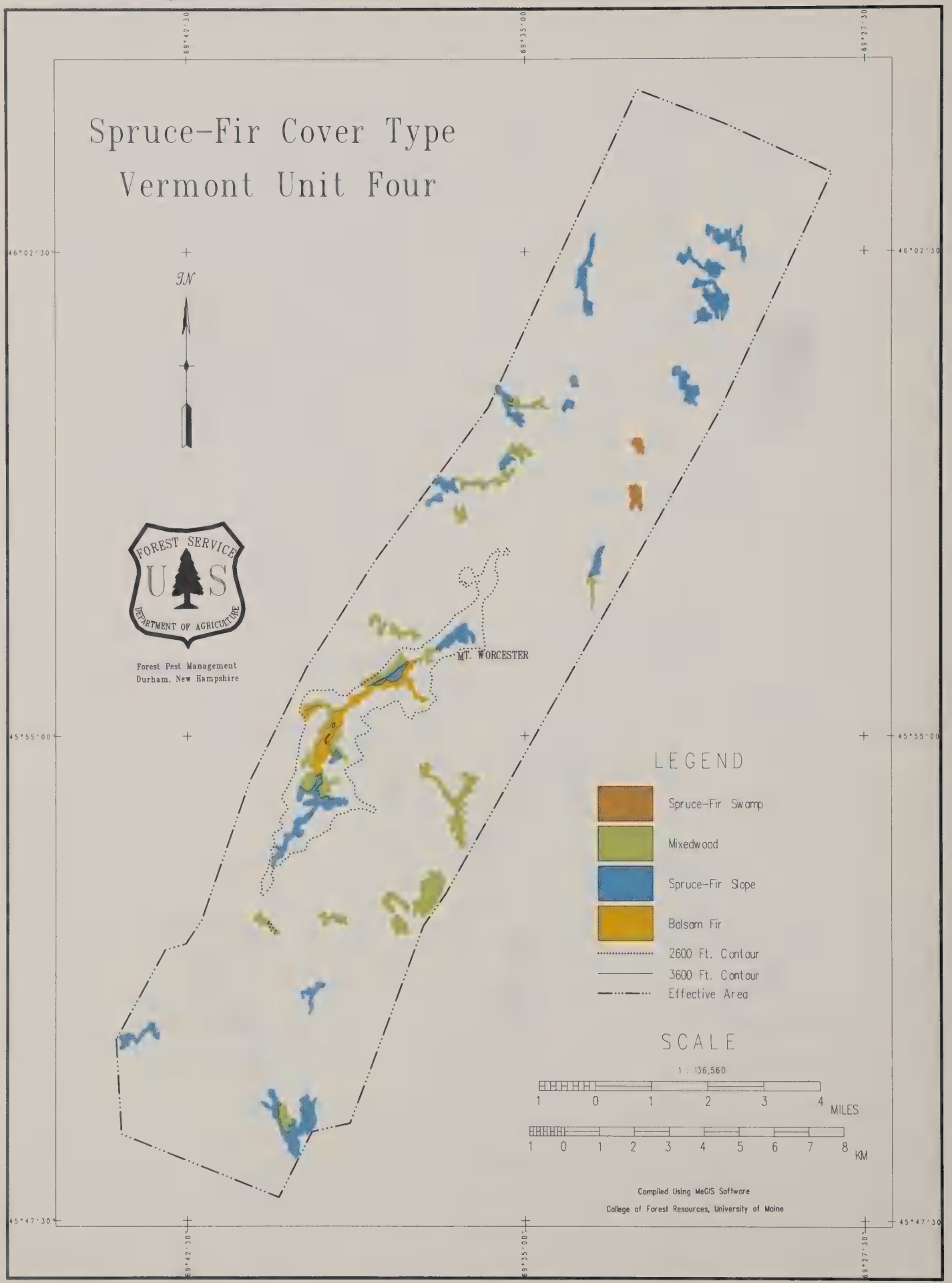

Spruce-Fir Cover Type
Vermont Unit Four
69°42'30"
69°35'00"
69°27'30"
46°02'30"
45°55'00"
45°47'30"
N
FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE
Forest Pest Management
Durham, New Hampshire
MT. WORCESTER
LEGEND
Spruce-Fir Swamp
Mixedwood
Spruce-Fir Slope
Balsam Fir
2600 Ft. Contour
3600 Ft. Contour
Effective Area
SCALE
1 : 136,560
1 0 1 2 3 4 MILES
1 0 1 2 3 4 5 6 7 8 KM
Compiled Using MeGIS Software
College of Forest Resources, University of Maine

FIGURE VT11.

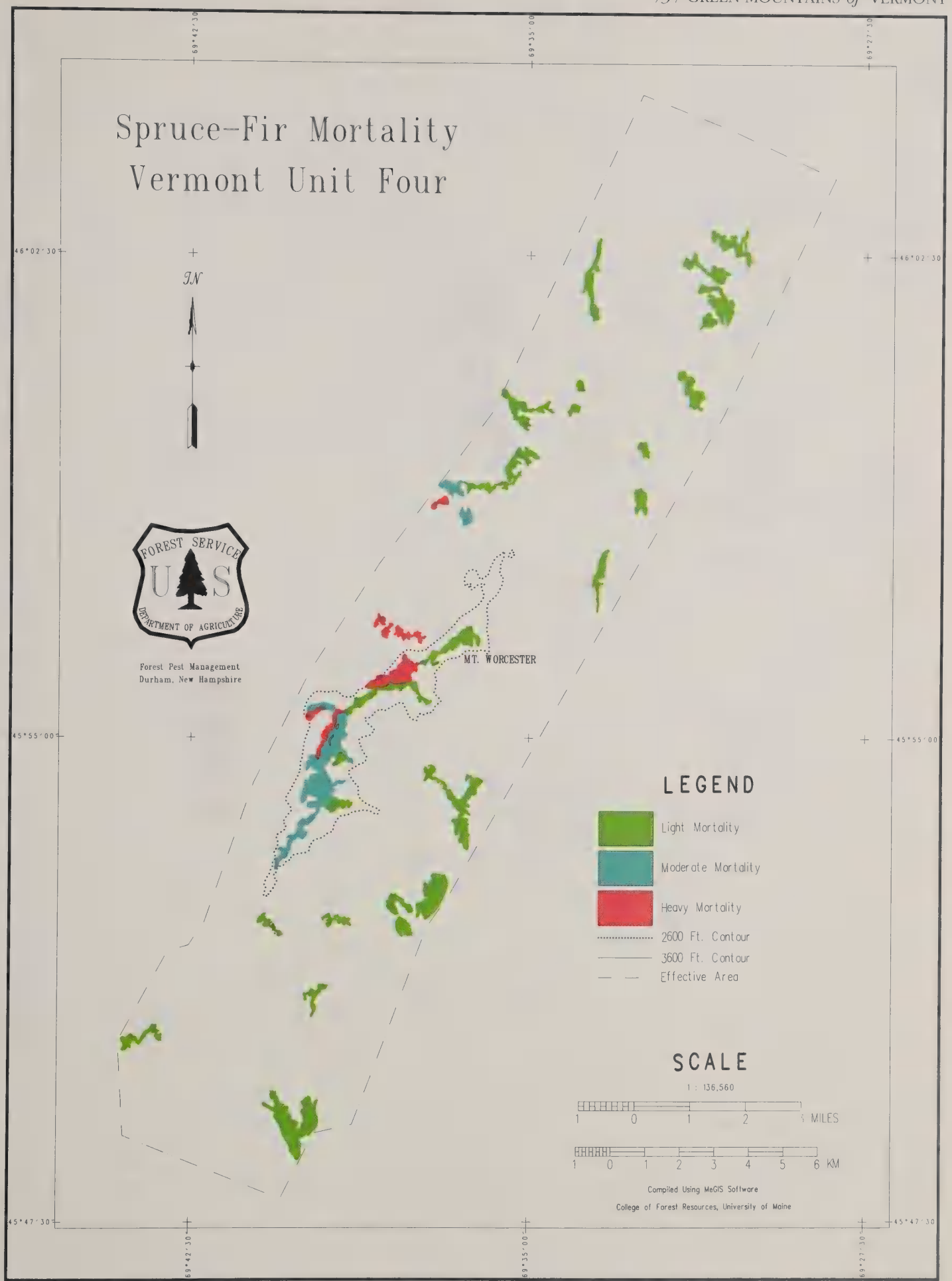

Spruce-Fir Mortality
Vermont Unit Four
69°42'30
69°35'00
69°27'30
46°02'30
45°55'00
45°47'30
N
FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE
Forest Pest Management
Durham, New Hampshire
MT. WORCESTER
LEGEND
Light Mortality
Moderate Mortality
Heavy Mortality
2600 Ft. Contour
3600 Ft. Contour
Effective Area
SCALE
1 : 136,560
1 0 1 2 3 MILES
1 0 1 2 3 4 5 6 KM
Compiled Using MaGIS Software
College of Forest Resources, University of Maine

FIGURE VT12.

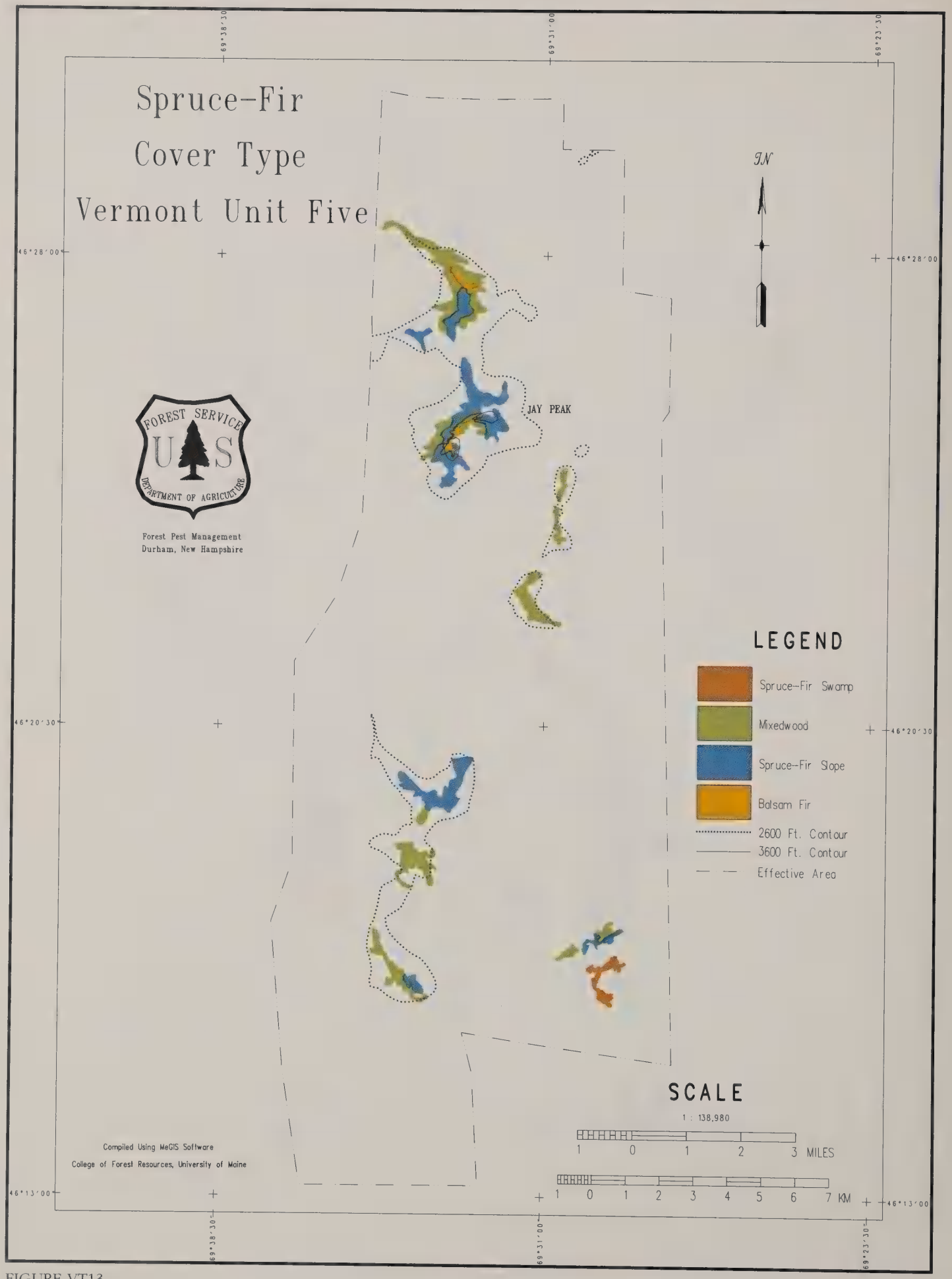

Spruce–Fir
Cover Type
Vermont Unit Five
JAY PEAK
FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE
Forest Pest Management
Durham, New Hampshire
LEGEND
Spruce–Fir Swamp
Mixedwood
Spruce–Fir Slope
Balsam Fir
2600 Ft. Contour
3600 Ft. Contour
Effective Area
SCALE
1 : 138,980
1 0 1 2 3 MILES
1 0 1 2 3 4 5 6 7 KM
Compiled Using MeGIS Software
College of Forest Resources, University of Maine
69°38'30
69°31'00
69°23'30
46°28'00
46°20'30
46°13'00

FIGURE VT13.

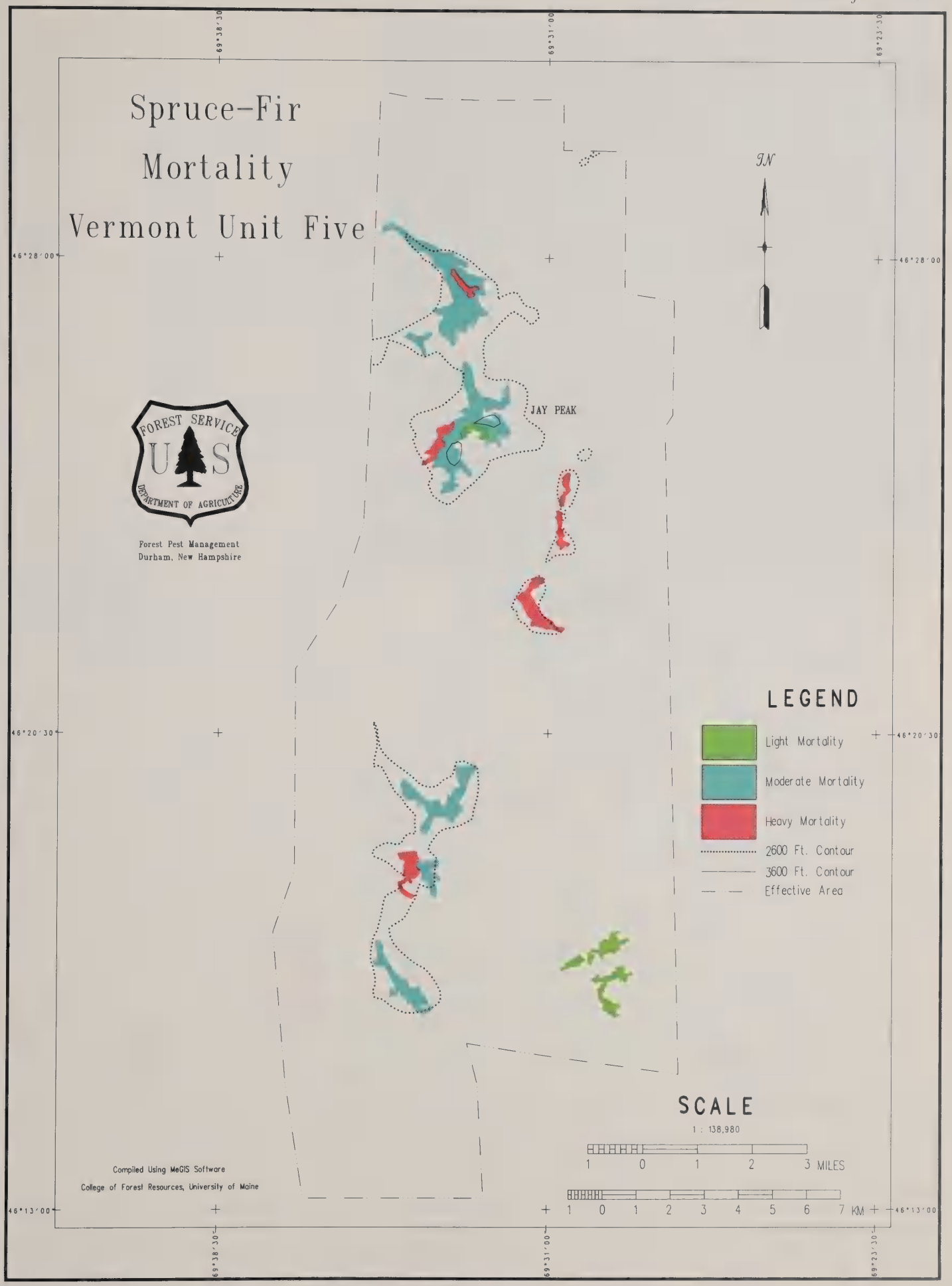

Spruce-Fir
Mortality
Vermont Unit Five
JAY PEAK
FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE
Forest Pest Management
Durham, New Hampshire
LEGEND
Light Mortality
Moderate Mortality
Heavy Mortality
2600 Ft. Contour
3600 Ft. Contour
Effective Area
SCALE
1 : 138,980
1 0 1 2 3 MILES
1 0 1 2 3 4 5 6 7 KM
Compiled Using MeGIS Software
College of Forest Resources, University of Maine
69°38'30"
69°31'00"
69°23'30"
46°28'00"
46°20'30"
46°13'00"

FIGURE VT14.

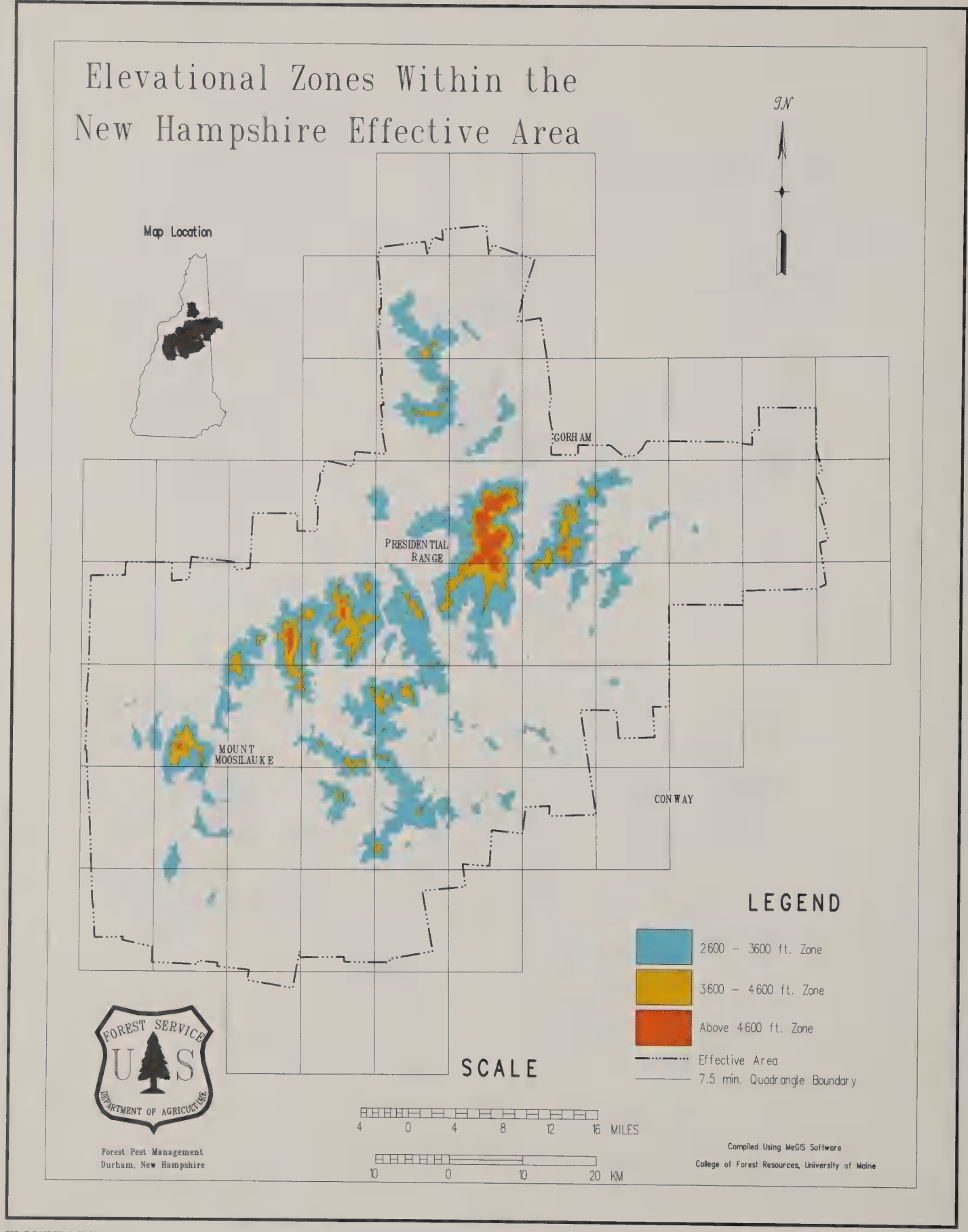

Elevational Zones Within the
New Hampshire Effective Area
N
Map Location
GORHAM
PRESIDENTIAL
RANGE
MOUNT
MOOSILAUKE
CONWAY
LEGEND
2600 – 3600 ft. Zone
3600 – 4600 ft. Zone
Above 4600 ft. Zone
Effective Area
7.5 min. Quadrangle Boundary
SCALE
4 0 4 8 12 16 MILES
10 0 10 20 KM
FOREST SERVICE
US
DEPARTMENT OF AGRICULTURE
Forest Pest Management
Durham, New Hampshire
Compiled Using MeGIS Software
College of Forest Resources, University of Maine

FIGURE NH1.

WHITE MOUNTAINS *of* NEW HAMPSHIRE

Almost all of the area photographed in New Hampshire is in the White Mountain National Forest in north central New Hampshire. On the west, the Forest is bounded by the Connecticut River Valley and on the east by the extension of Appalachian highlands into western Maine. The terrain in the White Mountains is very rugged with deep, narrow valleys and steep slopes. The mountains were formed by a combination of volcanic activity, folding, and thrust faulting, followed by intense glaciation (Gilluly et al. 1954). Unlike the north-south linear ridges of the Green Mountains, the White Mountains are an irregular arrangement of massifs running on a southwest-to-northeast diagonal parallel with the Appalachian highland system. There are eleven peaks above 5,000 ft and Mount Washington, the highest point in the Northeast, reaches 6,288 ft. The continental ice sheet deeply eroded the White Mountains, exposing large areas of granite and forming coarse soils of drift deposits (till, gravel, sand, and clay). The northern section of the White Mountains has higher peaks, more local relief, and more alpine glaciation features than the southern section. In the southern section, peaks are more rounded, with elevations of 2,500 to 4,000 ft., and more ponds, lakes, and flat valleys occur.

There is an extensive history of logging and fire within the spruce-fir forests on the White Mountain National Forest. The summits over 4,800 ft are above timberline, yet there are many lower peaks that are barren rock due to the destruction of the forest soil. Forests were affected by years of poor harvesting practices and severe fires associated with the logging railroads. Public outcry over exploitation led to creation of the White Mountain National Forest under the Weeks Act of 1911. Forests began to regenerate and reclaim cut over areas and abandoned farmland. The forest stands, in many areas previously pure conifer, changed partially or

completely to hardwoods. Today there are four wilderness areas on the 750,000-acre National Forest and about one-half of the area is managed for timber production.

Many insect, disease, and weather events historically have affected the growth of these forests. For instance, spruce budworm and spruce beetle have been periodic pests of spruce and fir (Hopkins 1901). By 1984, a spruce budworm infestation, apparently in progress for approximately two decades, affected over 60,000 acres of spruce-fir forests at the lower elevations in the White Mountains. The forests at the upper elevations are exposed to the prevailing high winds, resulting in windthrow and wind breakage. The highest winds recorded were 231 mph on the summit of Mount Washington in 1934. A hurricane in 1938 also caused substantial blowdown. These intermittent disturbances not only cause tree mortality, but affect growth rates and residual stand structure.

Figure NH1 illustrates the elevations in the photographed area of New Hampshire. Figure NH2 shows the distribution of mortality (standing dead) by cover type and Figure NH3 shows the distribution by elevation. Spruce-fir slope was, by far, the largest spruce-fir cover type in New Hampshire comprising about two-thirds of all the cover types mapped. Nearly one-half of the spruce-fir slope exhibited light mortality and most of that was at low elevations. The proportion of standing dead trees increased with elevation, and above 3600 ft approximately one-half of the spruce-fir slope area was in the heavy mortality class.

Most of the mixedwood was concentrated at the lowest elevations and approximately one-half of the type had light mortality. Mixedwood had far less heavy mortality than the spruce-fir slope. Less than one-half of the mixedwood, at elevations above 2,600 ft, exhibited moderate mortality and about one-quarter had heavy mortality. The proportion of mixedwood with heavy mortality did not increase dramatically with elevation as it did in spruce-fir slope. This may be due to the higher

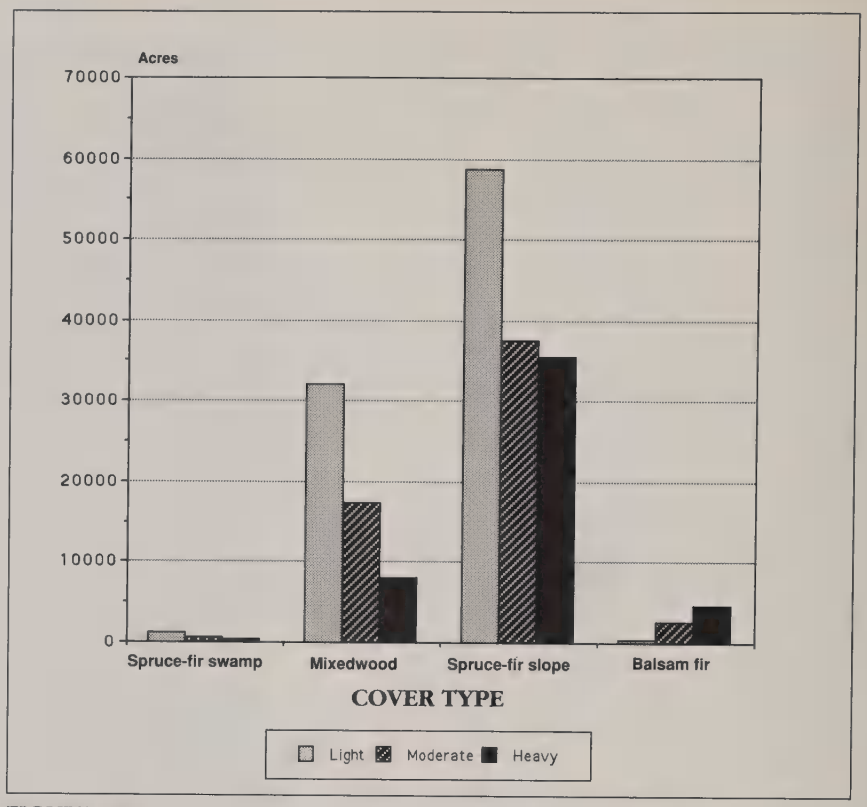


FIGURE NH2.
Distribution of mortality (standing dead) by cover type in the White Mountains of New Hampshire.

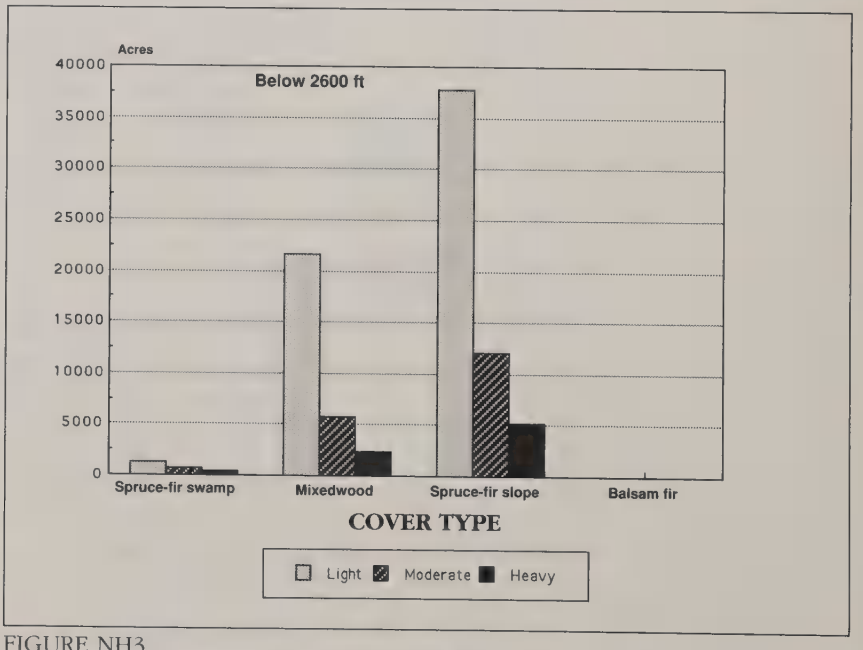


FIGURE NH3.
Distribution of mortality (standing head) by cover type and elevation in the White Mountains of New Hampshire.

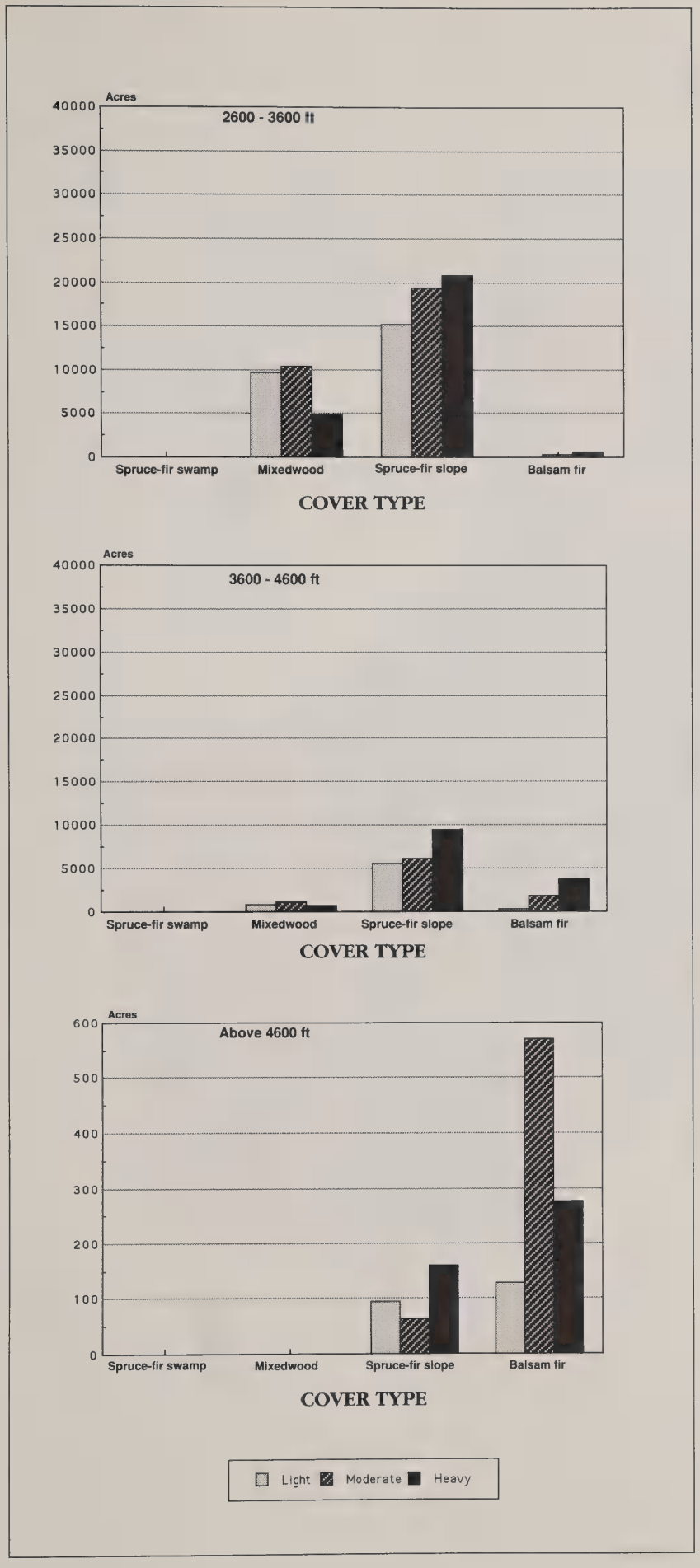


FIGURE NH3. CONTINUED
Distribution of mortality (standing dead) by cover type and elevation in the White Mountains of New Hampshire.

quality of the mixedwood sites.

Over three-quarters of the balsam fir occurred between 3,600 ft and 4,600 ft, and most of it was in the heavy mortality class. At elevations greater than 4,600 ft, most balsam fir stands had moderate mortality; illustrated on the New Hampshire Unit Three Maps where the balsam fir occurs near timberline in the Presidential Range (Figure NH 4). New Hampshire had a high incidence of fir waves, occurring in an estimated 42 percent of the area with heavy mortality and 19 percent of the moderate mortality area. Very little of the spruce-fir cover type mapped in the White Mountains was spruce-fir swamp and about one-half had light mortality.

Figure NH4 is an index of the six mapping units in New Hampshire. A portion of the White Mountain National Forest extends into the State of Maine, however, the maps and acreage summaries of the spruce-fir forest in that area have been included in New Hampshire. The western half of Maine Photo-Block One covers an area in New Hampshire adjacent to the National Forest. This area is displayed in the Maine mapping units, but the acreage summaries are included with New Hampshire. Figures NH5-NH16 display the cover types and mortality in each unit.

Figure NH17 is a map of spruce-fir cover type and mortality class in the 7.5-min Mt. Moosilauke quadrangle. Like Whiteface Mountain in New York, numerous research projects are being conducted on Mt. Moosilauke to determine the condition of the forest resource (Peart et al. 1988). The total area of spruce-fir cover type was approximately 8,500 acres, with 64 percent spruce-fir slope and 28 percent mixedwood. Approximately 52 percent of the spruce-fir slope, and only 18 percent of the mixedwood, was in the moderate and heavy mortality classes. ❧

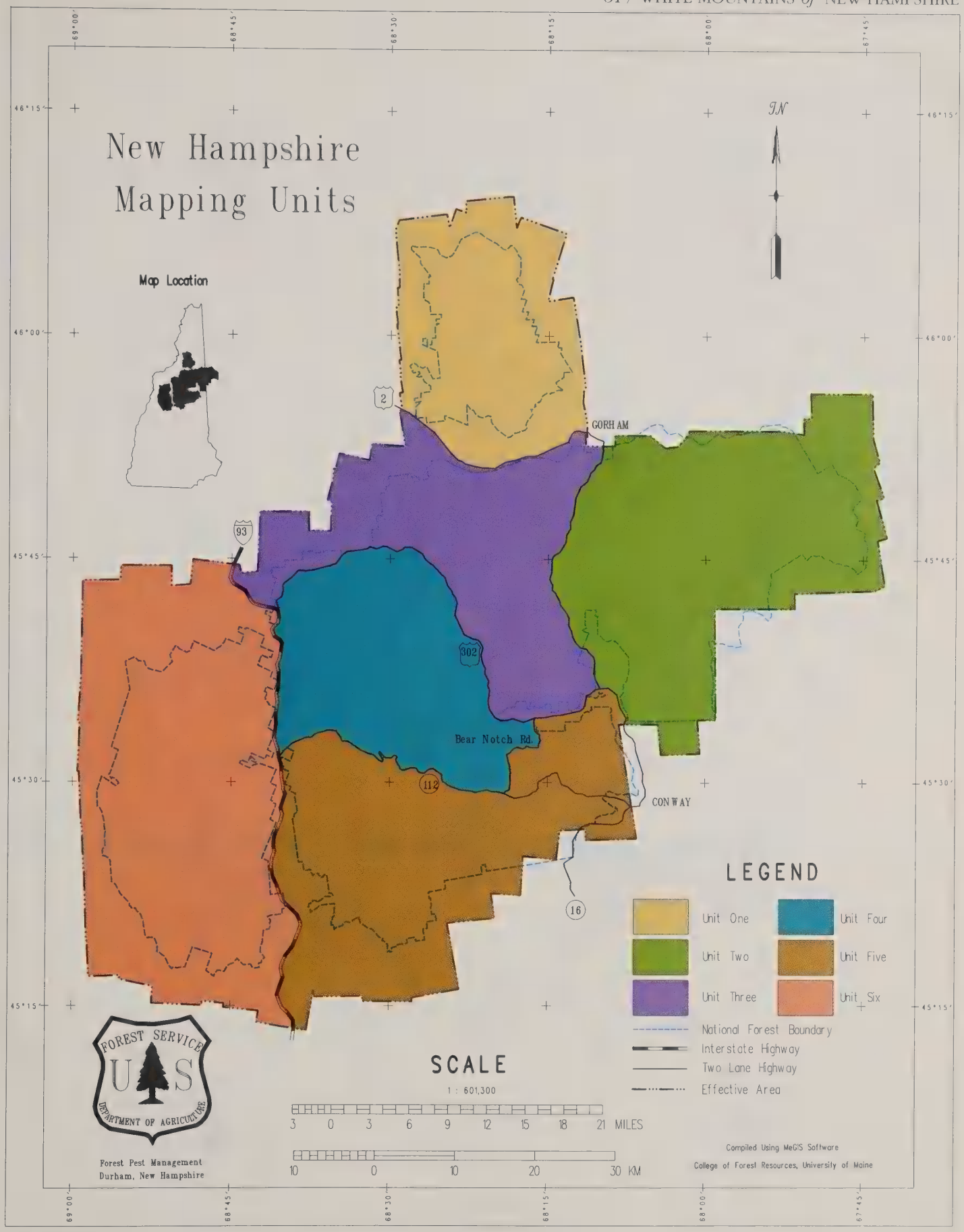

New Hampshire
Mapping Units
Map Location
N
GORHAM
CONWAY
Bear Notch Rd.
2
93
302
112
16
LEGEND
Unit One
Unit Two
Unit Three
Unit Four
Unit Five
Unit Six
National Forest Boundary
Interstate Highway
Two Lane Highway
Effective Area
SCALE
1 : 601,300
3 0 3 6 9 12 15 18 21 MILES
10 0 10 20 30 KM
FOREST SERVICE
US
DEPARTMENT OF AGRICULTURE
Forest Pest Management
Durham, New Hampshire
Compiled Using MeGIS Software
College of Forest Resources, University of Maine

FIGURE NH4.

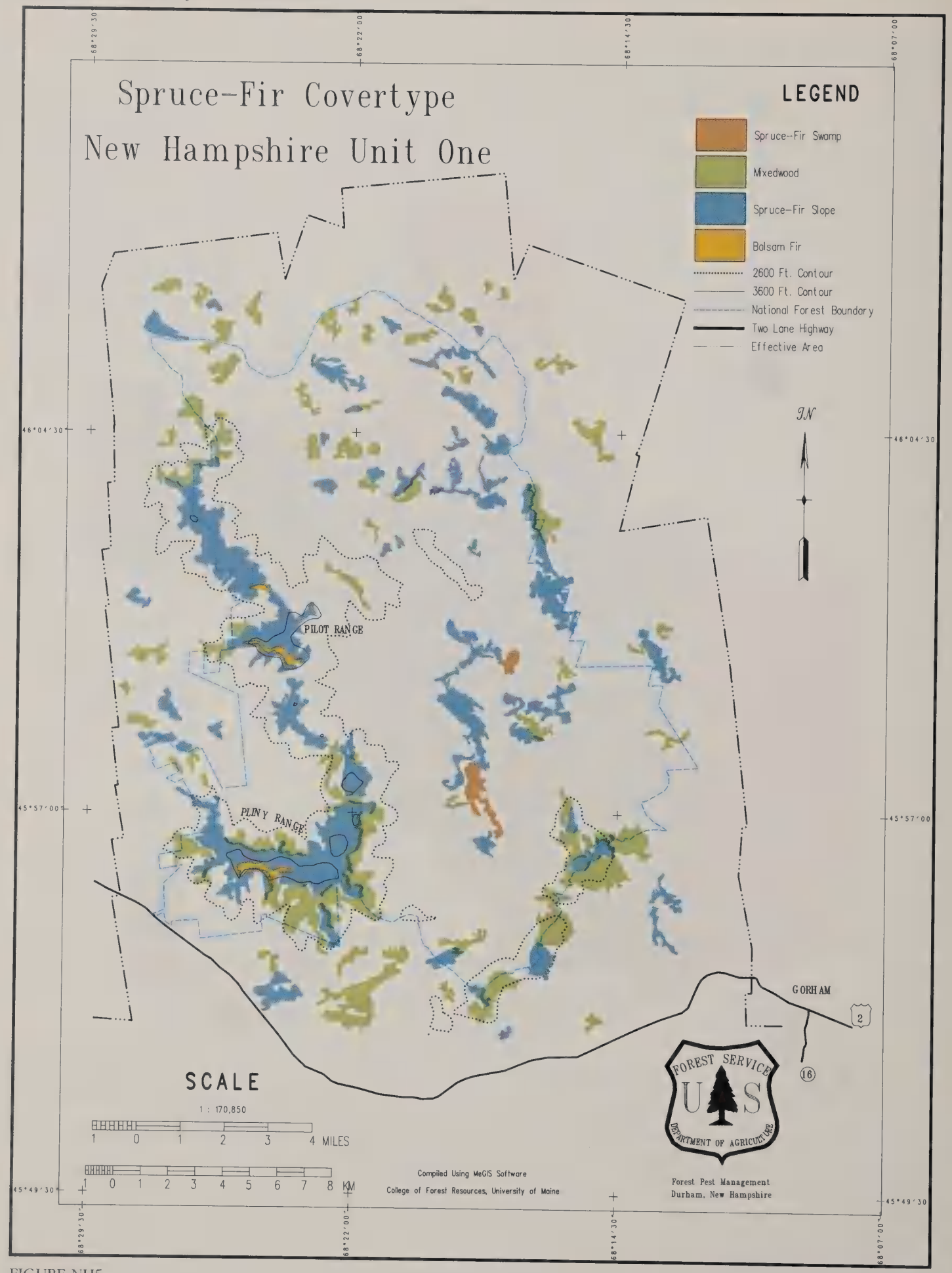

Spruce-Fir Covertype
New Hampshire Unit One
LEGEND
Spruce--Fir Swamp
Mixedwood
Spruce-Fir Slope
Balsam Fir
2600 Ft. Contour
3600 Ft. Contour
National Forest Boundary
Two Lane Highway
Effective Area
68°29'30"
68°22'00"
68°14'30"
68°07'00"
46°04'30"
45°57'00"
45°49'30"
PILOT RANGE
PLINY RANGE
GORHAM
2
16
SCALE
1 : 170,850
1 0 1 2 3 4 MILES
1 0 1 2 3 4 5 6 7 8 KM
Compiled Using MeGIS Software
College of Forest Resources, University of Maine
FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE
Forest Pest Management
Durham, New Hampshire

FIGURE NH5.

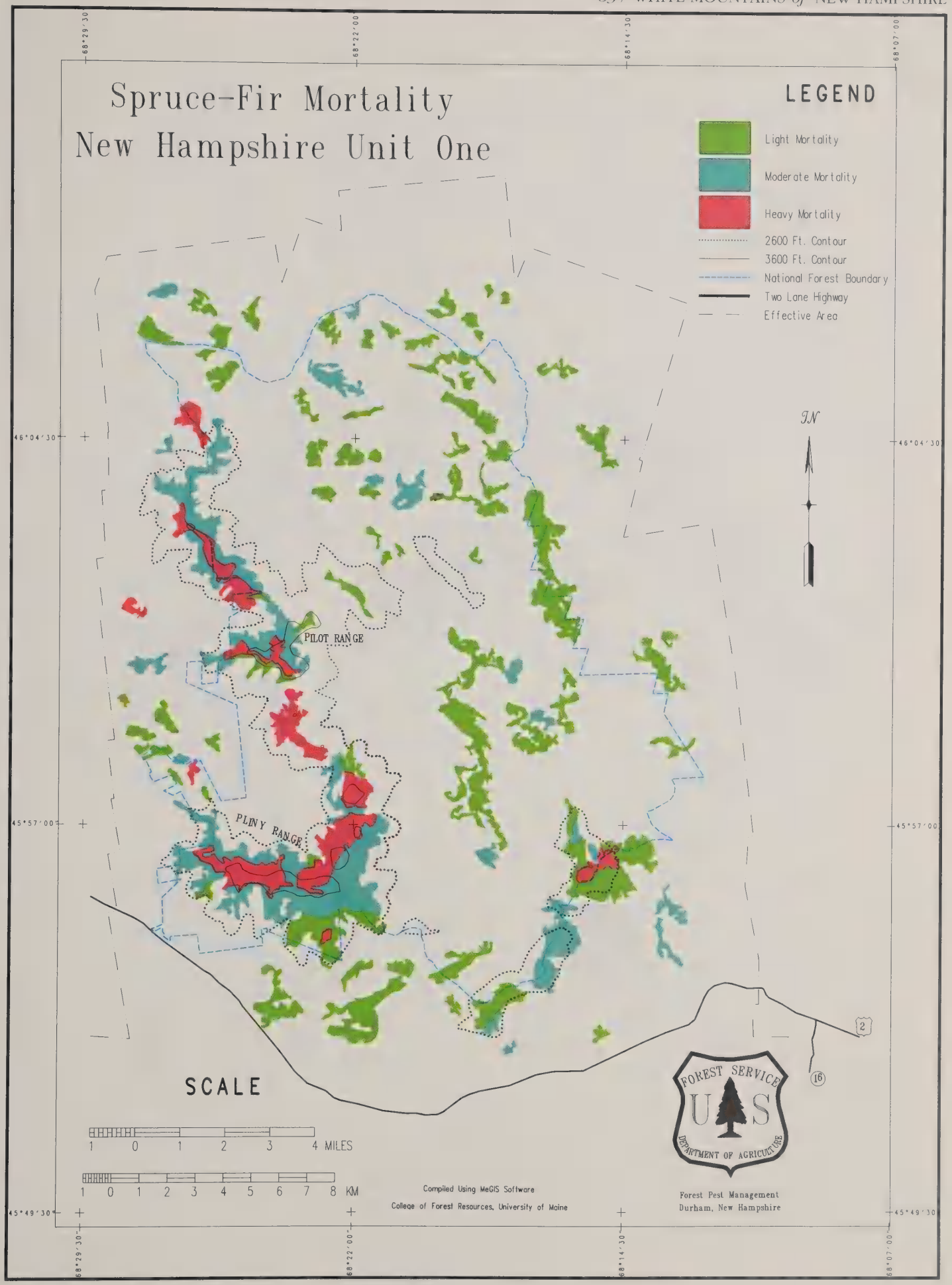

Spruce-Fir Mortality
New Hampshire Unit One
LEGEND
Light Mortality
Moderate Mortality
Heavy Mortality
2600 Ft. Contour
3600 Ft. Contour
National Forest Boundary
Two Lane Highway
Effective Area
N
PILOT RANGE
PLINY RANGE
SCALE
1 0 1 2 3 4 MILES
1 0 1 2 3 4 5 6 7 8 KM
Compiled Using MeGIS Software
College of Forest Resources, University of Maine
FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE
Forest Pest Management
Durham, New Hampshire
68°29'30"
68°22'00"
68°14'30"
68°07'00"
46°04'30"
45°57'00"
45°49'30"
2
16

FIGURE NH6.

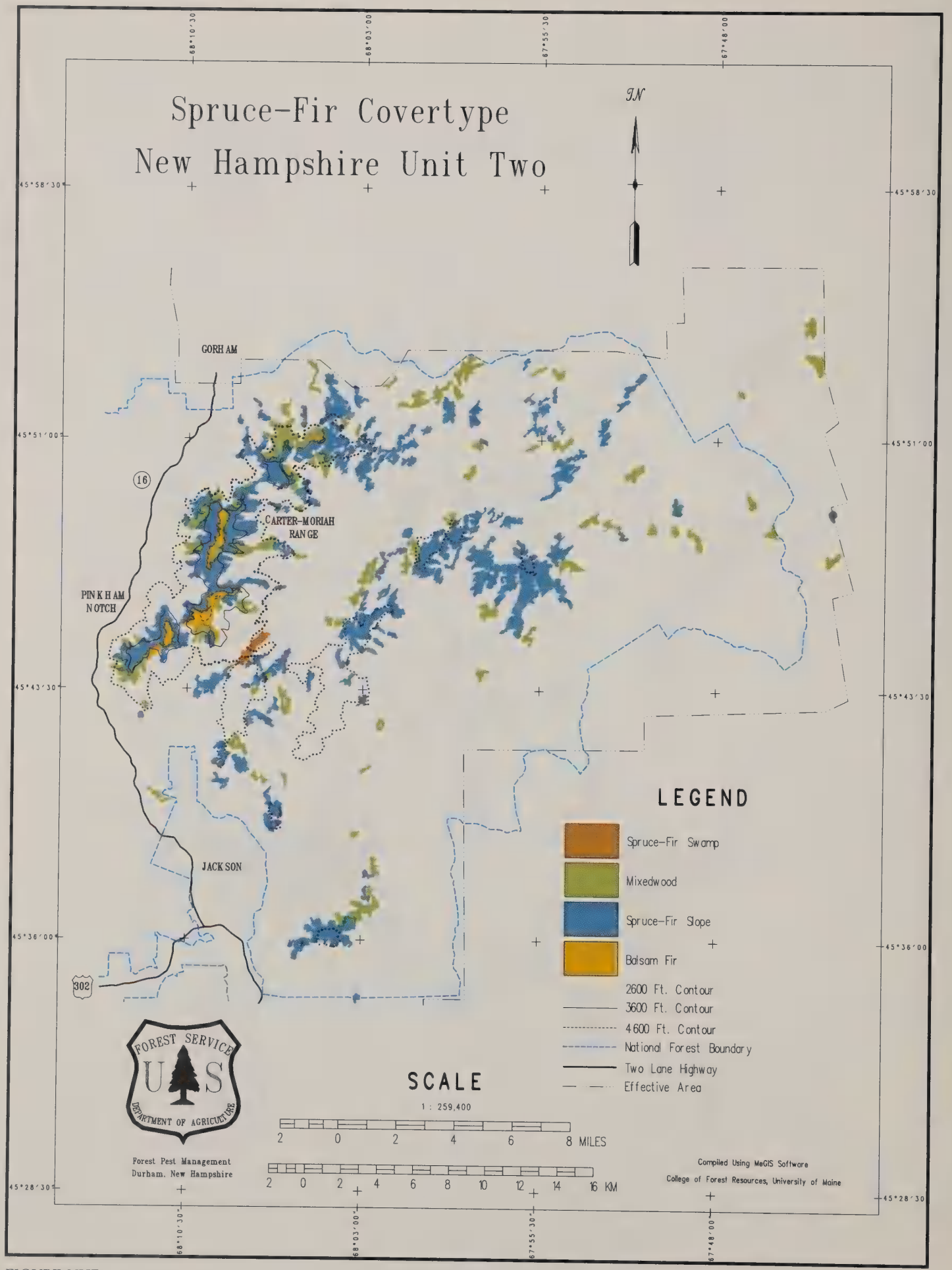

Spruce-Fir Covertype
New Hampshire Unit Two
N
68°10'30"
68°03'00"
67°55'30"
67°48'00"
45°58'30"
45°51'00"
45°43'30"
45°36'00"
45°28'30"
GORHAM
CARTER-MORIAH RANGE
PINKHAM NOTCH
JACKSON
16
302
LEGEND
Spruce-Fir Swamp
Mixedwood
Spruce-Fir Slope
Balsam Fir
2600 Ft. Contour
3600 Ft. Contour
4600 Ft. Contour
National Forest Boundary
Two Lane Highway
Effective Area
SCALE
1 : 259,400
2 0 2 4 6 8 MILES
2 0 2 4 6 8 10 12 14 16 KM
FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE
Forest Pest Management
Durham, New Hampshire
Compiled Using MeGIS Software
College of Forest Resources, University of Maine

FIGURE NH7.

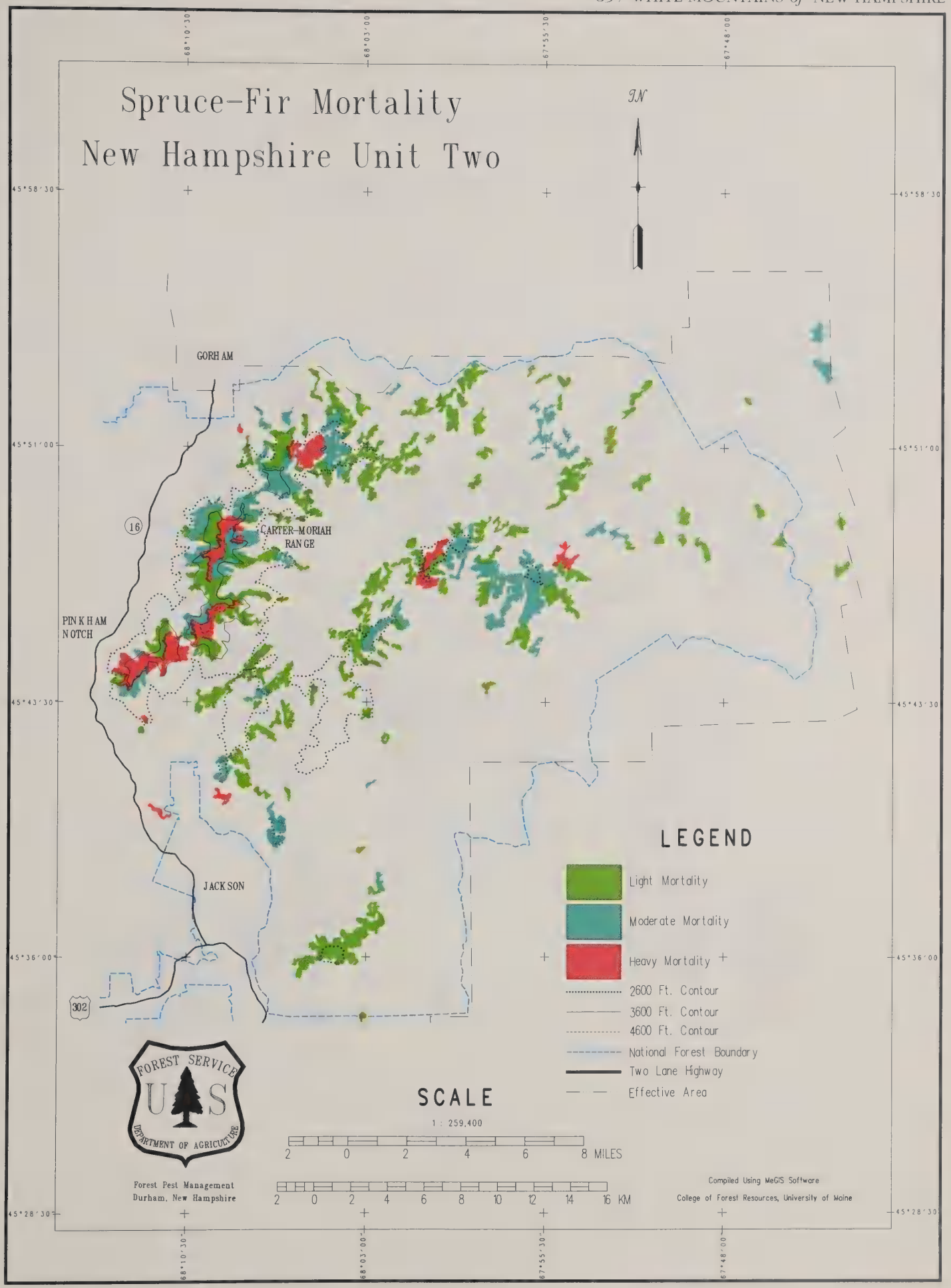

Spruce-Fir Mortality
New Hampshire Unit Two
N
GORHAM
CARTER-MORIAH RANGE
PINKHAM NOTCH
JACKSON
16
302
68°10'30"
68°03'00"
67°55'30"
67°48'00"
45°58'30"
45°51'00"
45°43'30"
45°36'00"
45°28'30"
LEGEND
Light Mortality
Moderate Mortality
Heavy Mortality
2600 Ft. Contour
3600 Ft. Contour
4600 Ft. Contour
National Forest Boundary
Two Lane Highway
Effective Area
SCALE
1 : 259,400
2 0 2 4 6 8 MILES
2 0 2 4 6 8 10 12 14 16 KM
FOREST SERVICE
US
DEPARTMENT OF AGRICULTURE
Forest Pest Management
Durham, New Hampshire
Compiled Using MeGIS Software
College of Forest Resources, University of Maine

FIGURE NH8.

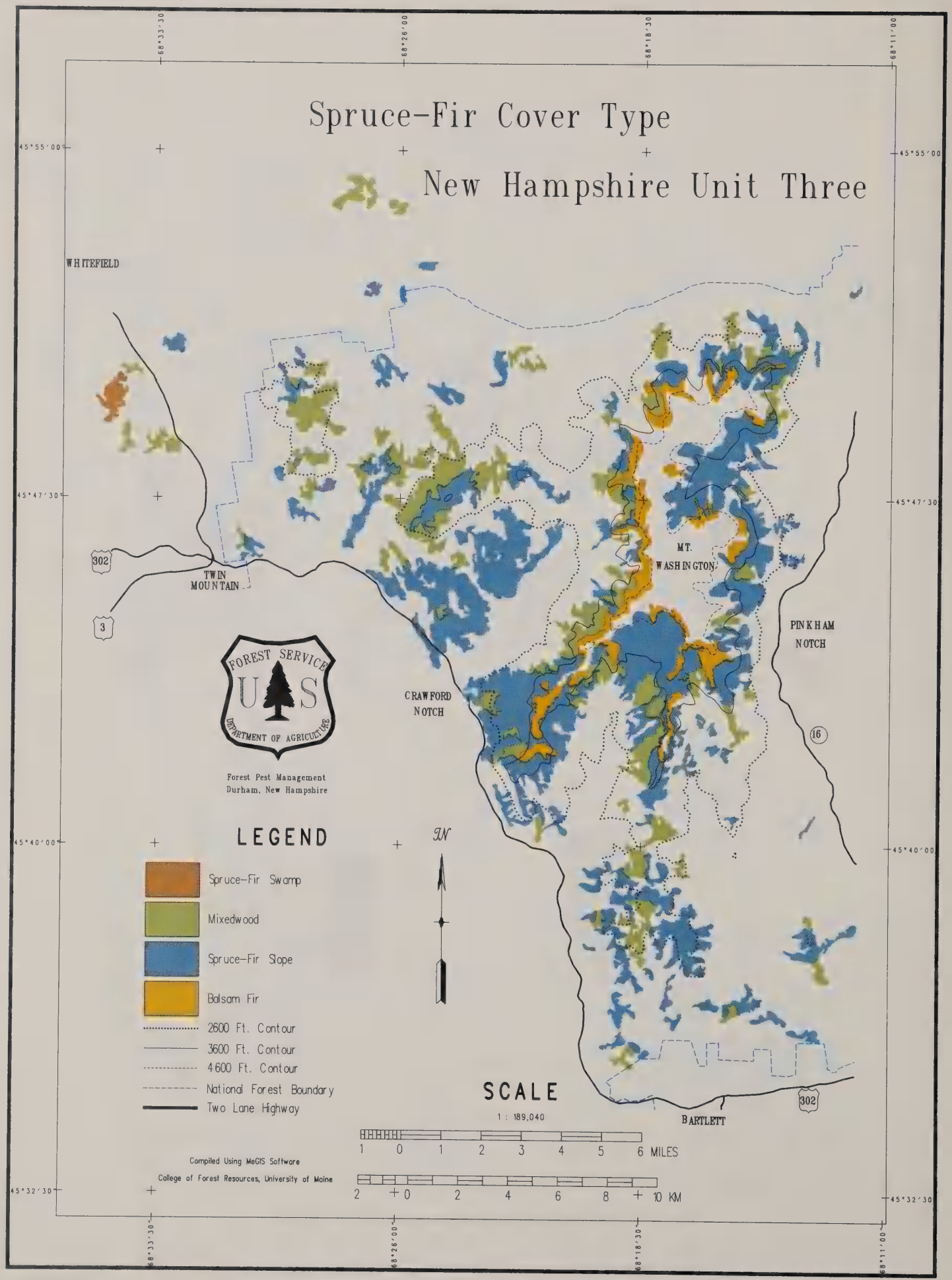

Spruce-Fir Cover Type
New Hampshire Unit Three
WHITEFIELD
TWIN MOUNTAIN
MT. WASHINGTON
PINKHAM NOTCH
CRAWFORD NOTCH
BARTLETT
302
3
16
68°33'30"
68°26'00"
68°18'30"
68°11'00"
45°55'00"
45°47'30"
45°40'00"
45°32'30"
FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE
Forest Pest Management
Durham, New Hampshire
LEGEND
Spruce-Fir Swamp
Mixedwood
Spruce-Fir Slope
Balsam Fir
2600 Ft. Contour
3600 Ft. Contour
4600 Ft. Contour
National Forest Boundary
Two Lane Highway
N
SCALE
1 : 189,040
1 0 1 2 3 4 5 6 MILES
2 0 2 4 6 8 10 KM
Compiled Using MeGIS Software
College of Forest Resources, University of Maine

FIGURE NH9.

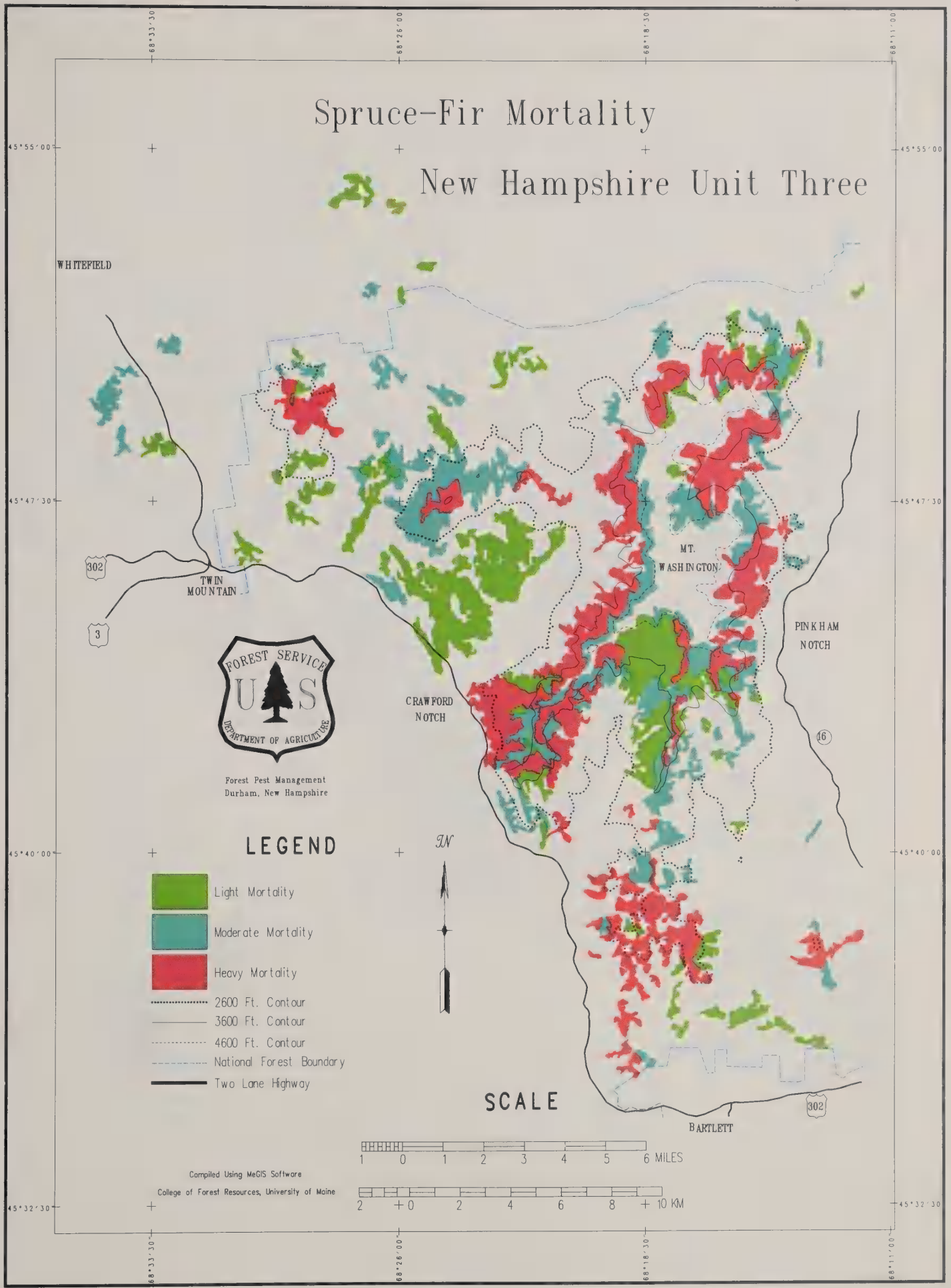

Spruce-Fir Mortality
New Hampshire Unit Three
WHITEFIELD
TWIN MOUNTAIN
302
3
MT. WASHINGTON
CRAWFORD NOTCH
PINKHAM NOTCH
16
302
BARTLETT
FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE
Forest Pest Management
Durham, New Hampshire
LEGEND
Light Mortality
Moderate Mortality
Heavy Mortality
2600 Ft. Contour
3600 Ft. Contour
4600 Ft. Contour
National Forest Boundary
Two Lane Highway
N
SCALE
1 0 1 2 3 4 5 6 MILES
2 + 0 2 4 6 8 + 10 KM
Compiled Using MeGIS Software
College of Forest Resources, University of Maine
68°33'30"
68°26'00"
68°18'30"
68°11'00"
45°55'00"
45°47'30"
45°40'00"
45°32'30"

FIGURE NH10.

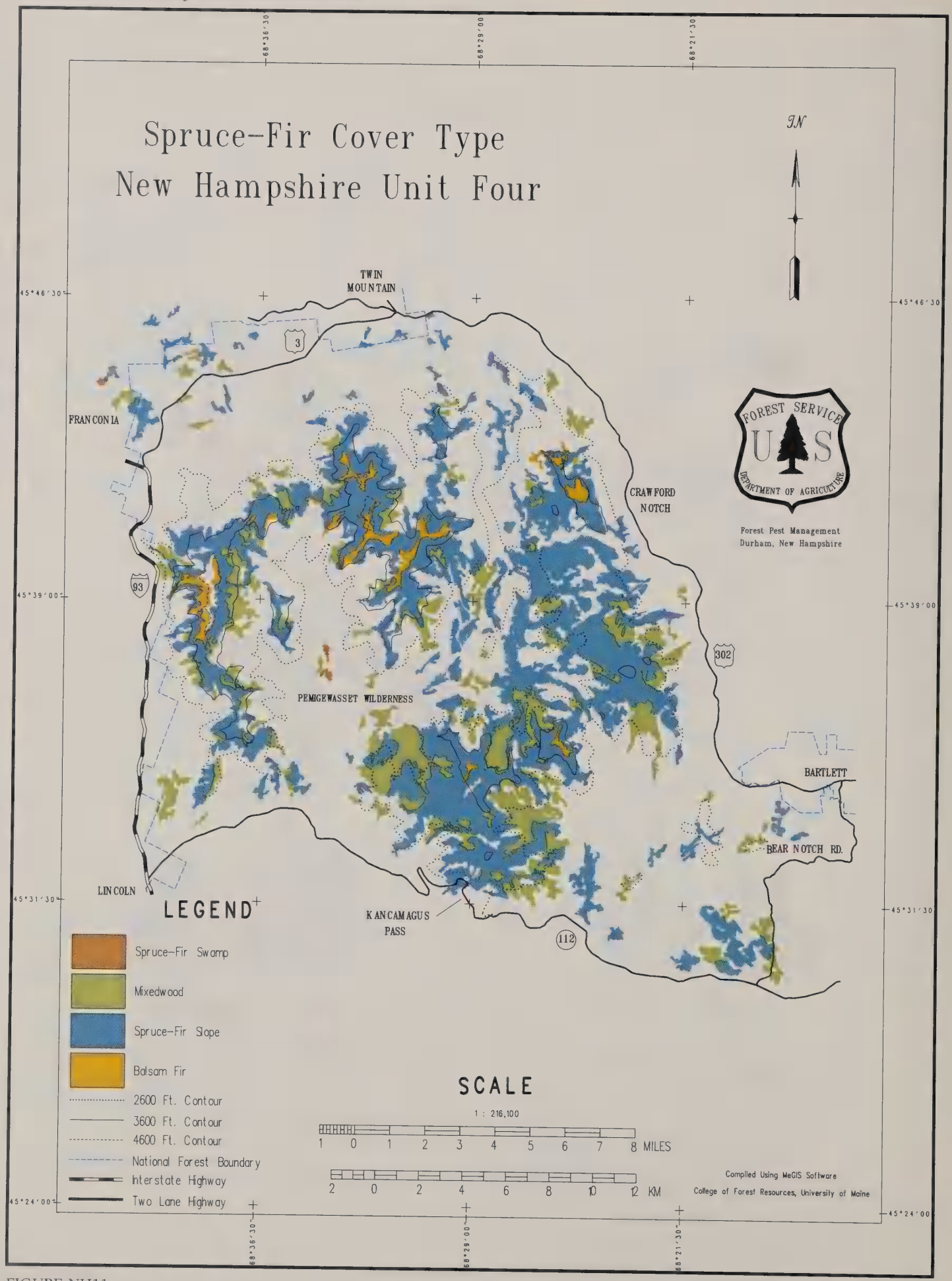

Spruce-Fir Cover Type
New Hampshire Unit Four
TWIN MOUNTAIN
FRANCONIA
CRAWFORD NOTCH
PEMIGEWASSET WILDERNESS
BARTLETT
BEAR NOTCH RD.
LINCOLN
KANCAMAGUS PASS
FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE
Forest Pest Management
Durham, New Hampshire
LEGEND
Spruce-Fir Swamp
Mixedwood
Spruce-Fir Slope
Balsam Fir
2600 Ft. Contour
3600 Ft. Contour
4600 Ft. Contour
National Forest Boundary
Interstate Highway
Two Lane Highway
SCALE
1 : 216,100
1 0 1 2 3 4 5 6 7 8 MILES
2 0 2 4 6 8 10 12 KM
Compiled Using MeGIS Software
College of Forest Resources, University of Maine
68°36'30"
68°29'00"
68°21'30"
45°46'30"
45°39'00"
45°31'30"
45°24'00"

FIGURE NH11.

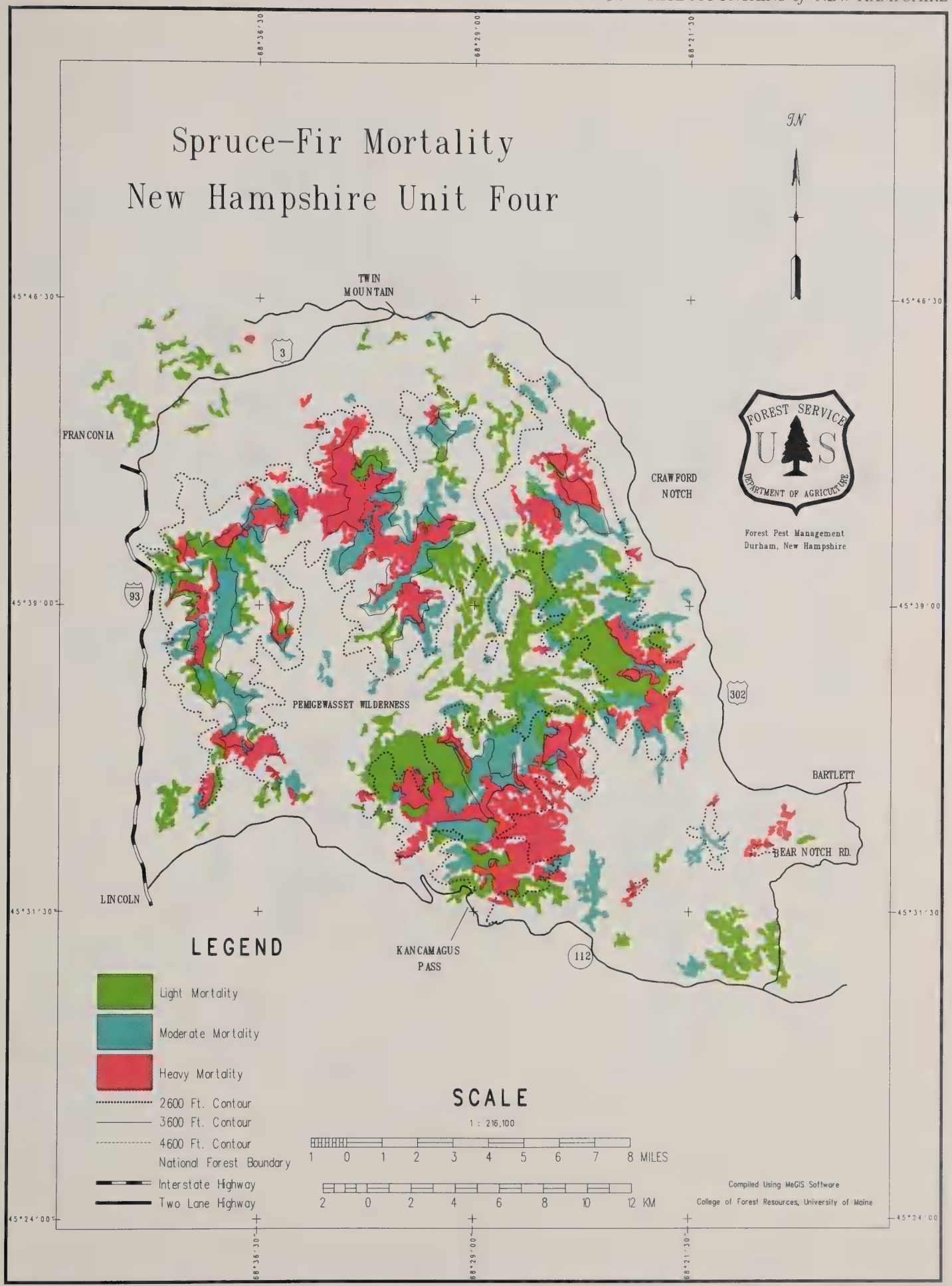

Spruce-Fir Mortality
New Hampshire Unit Four
TWIN MOUNTAIN
FRANCONIA
CRAWFORD NOTCH
PEMIGEWASSET WILDERNESS
BARTLETT
BEAR NOTCH RD.
LINCOLN
KANCAMAGUS PASS
3
93
302
112
FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE
Forest Pest Management
Durham, New Hampshire
LEGEND
Light Mortality
Moderate Mortality
Heavy Mortality
2600 Ft. Contour
3600 Ft. Contour
4600 Ft. Contour
National Forest Boundary
Interstate Highway
Two Lane Highway
SCALE
1 : 216,100
1 0 1 2 3 4 5 6 7 8 MILES
2 0 2 4 6 8 10 12 KM
Compiled Using MeGIS Software
College of Forest Resources, University of Maine
68°36'30"
68°29'00"
68°21'30"
45°46'30"
45°39'00"
45°31'30"
45°24'00"

FIGURE NH12.


Spruce-Fir Cover Type
New Hampshire Unit Five
LEGEND
Spruce-Fir Swamp
Mixedwood
Spruce-Fir Slope
2600 Ft. Contour
3600 Ft. Contour
National Forest Boundary
Interstate Highway
Two Lane Highway
Effective Area
SCALE
6 MILES
10 KM
FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE
Forest Pest Management
Durham, New Hampshire
Compiled Using MaGIS Software
College of Forest Resources, University of Maine
BEAR NOTCH RD.
MT. CHOCORUA
KANCAMAGUS PASS
WATERVILLE VALLEY
LINCOLN
302
112
16
93

FIGURE NH13.

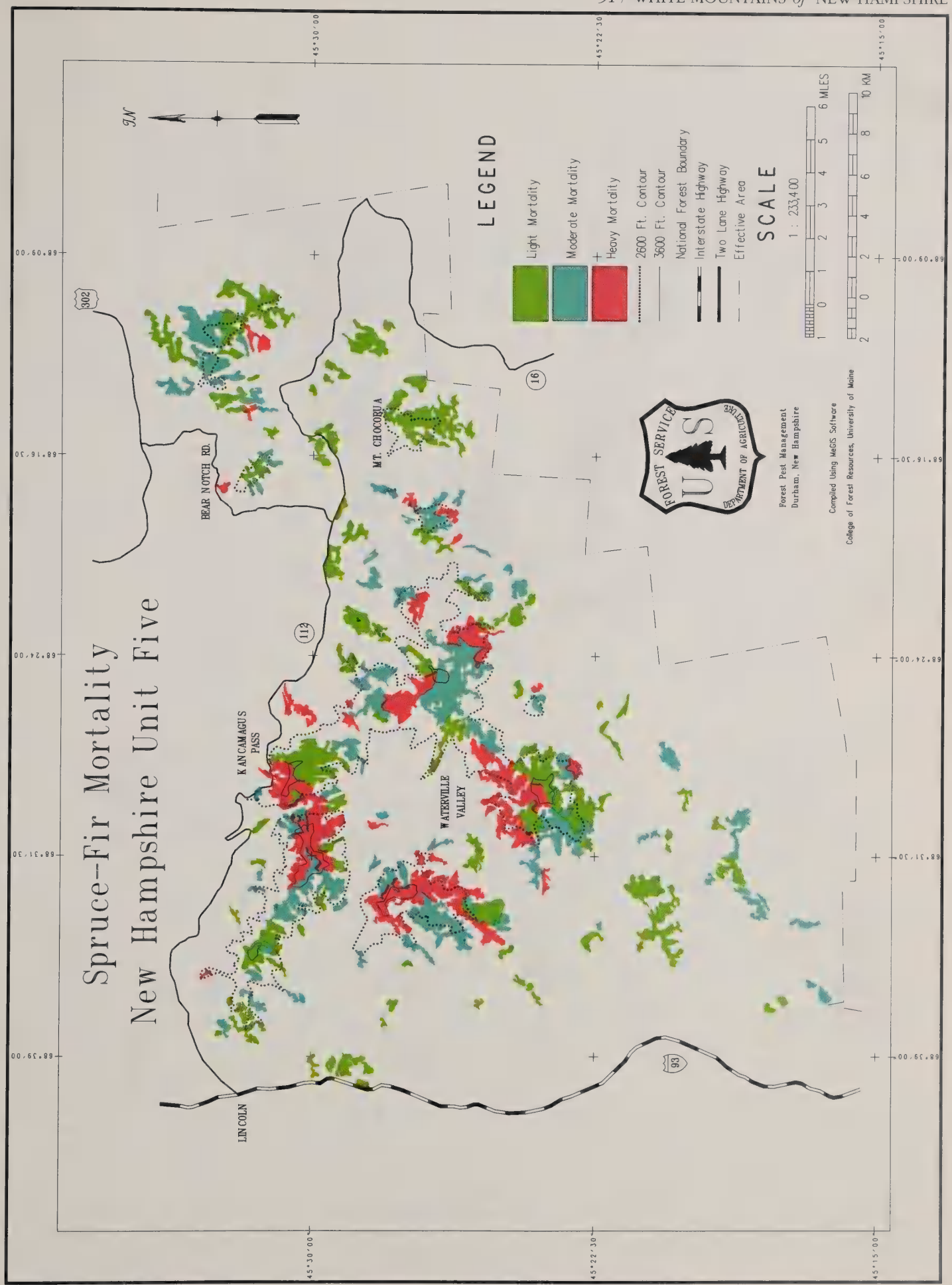

Spruce-Fir Mortality
New Hampshire Unit Five
LEGEND
Light Mortality
Moderate Mortality
Heavy Mortality
2600 Ft. Contour
3600 Ft. Contour
National Forest Boundary
Interstate Highway
Two Lane Highway
Effective Area
SCALE
1 : 233,400
6 MILES
10 KM
FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE
Forest Pest Management
Durham, New Hampshire
Compiled Using MaGIS Software
College of Forest Resources, University of Maine
BEAR NOTCH RD.
MT. CHOCORUA
KANCAMAGUS PASS
WATERVILLE VALLEY
LINCOLN
302
16
112
93
N
45°30'00
45°22'30
45°15'00
68°09'00
68°16'30
68°24'00
68°31'30
68°39'00

FIGURE NH14.

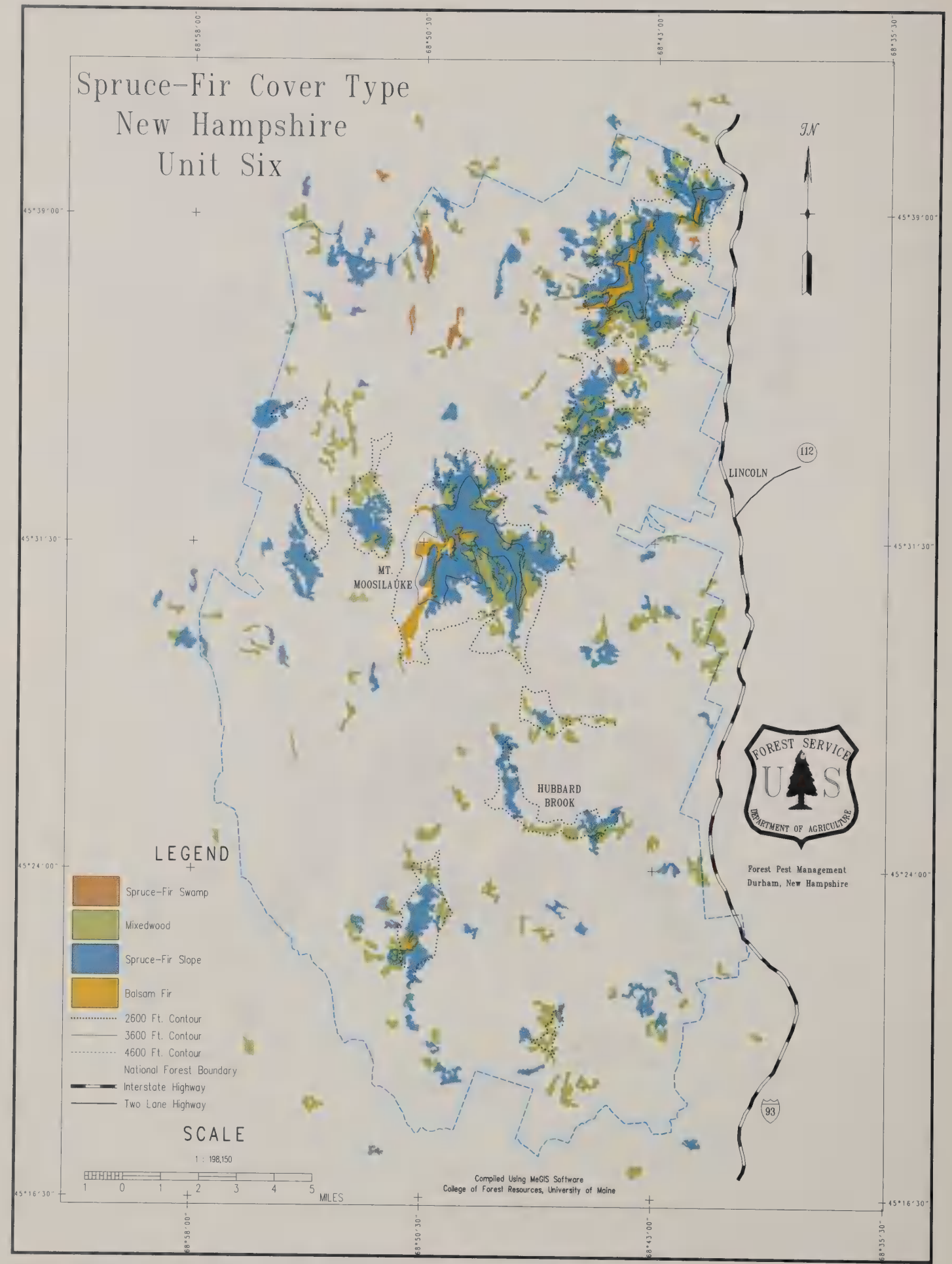

Spruce–Fir Cover Type
New Hampshire
Unit Six
68°58'00"
68°50'30"
68°43'00"
68°35'30"
45°39'00"
45°31'30"
45°24'00"
45°16'30"
N
LINCOLN
112
MT.
MOOSILAUKE
HUBBARD
BROOK
93
FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE
Forest Pest Management
Durham, New Hampshire
LEGEND
Spruce–Fir Swamp
Mixedwood
Spruce–Fir Slope
Balsam Fir
2600 Ft. Contour
3600 Ft. Contour
4600 Ft. Contour
National Forest Boundary
Interstate Highway
Two Lane Highway
SCALE
1 : 198,150
1 0 1 2 3 4 5
MILES
Compiled Using MeGIS Software
College of Forest Resources, University of Maine

FIGURE NH15.

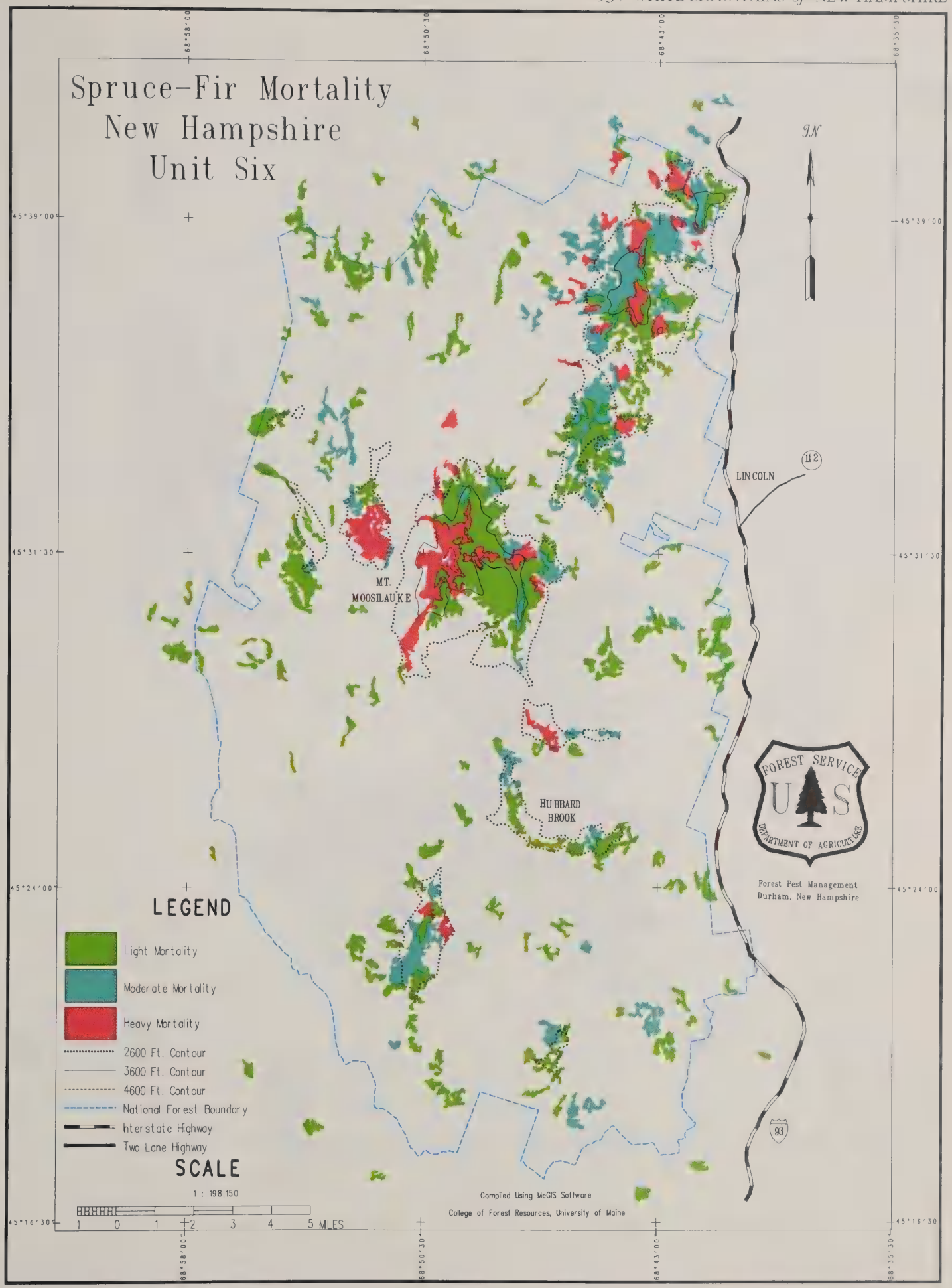

Spruce-Fir Mortality
New Hampshire
Unit Six
68°58'00
68°50'30
68°43'00
68°35'30
45°39'00
45°31'30
45°24'00
45°16'30
IN
112
LINCOLN
MT.
MOOSILAUKE
HUBBARD
BROOK
93
FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE
Forest Pest Management
Durham, New Hampshire
LEGEND
Light Mortality
Moderate Mortality
Heavy Mortality
2600 Ft. Contour
3600 Ft. Contour
4600 Ft. Contour
National Forest Boundary
Interstate Highway
Two Lane Highway
SCALE
1 : 198,150
1 0 1 2 3 4 5 MILES
Compiled Using MeGIS Software
College of Forest Resources, University of Maine

FIGURE NH16.

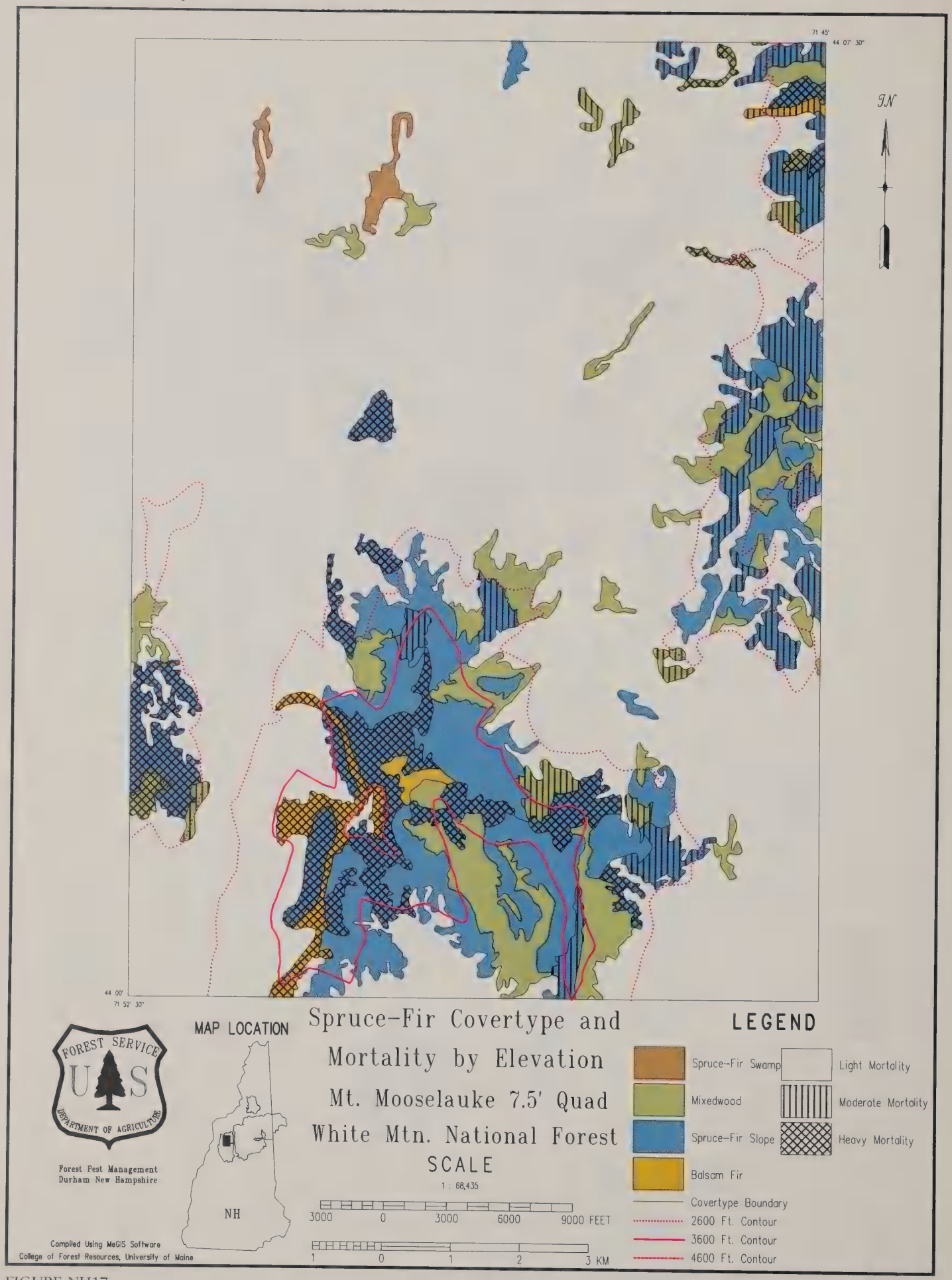

71 45'
44 07' 30"
44 00'
71 52' 30"
N
Spruce-Fir Covertype and
Mortality by Elevation
Mt. Mooselauke 7.5' Quad
White Mtn. National Forest
SCALE
1 : 68,435
3000 0 3000 6000 9000 FEET
1 0 1 2 3 KM
MAP LOCATION
NH
FOREST SERVICE
US
DEPARTMENT OF AGRICULTURE
Forest Pest Management
Durham New Hampshire
Compiled Using MeGIS Software
College of Forest Resources, University of Maine
LEGEND
Spruce--Fir Swamp
Mixedwood
Spruce--Fir Slope
Balsam Fir
Covertype Boundary
2600 Ft. Contour
3600 Ft. Contour
4600 Ft. Contour
Light Mortality
Moderate Mortality
Heavy Mortality

FIGURE NH17.

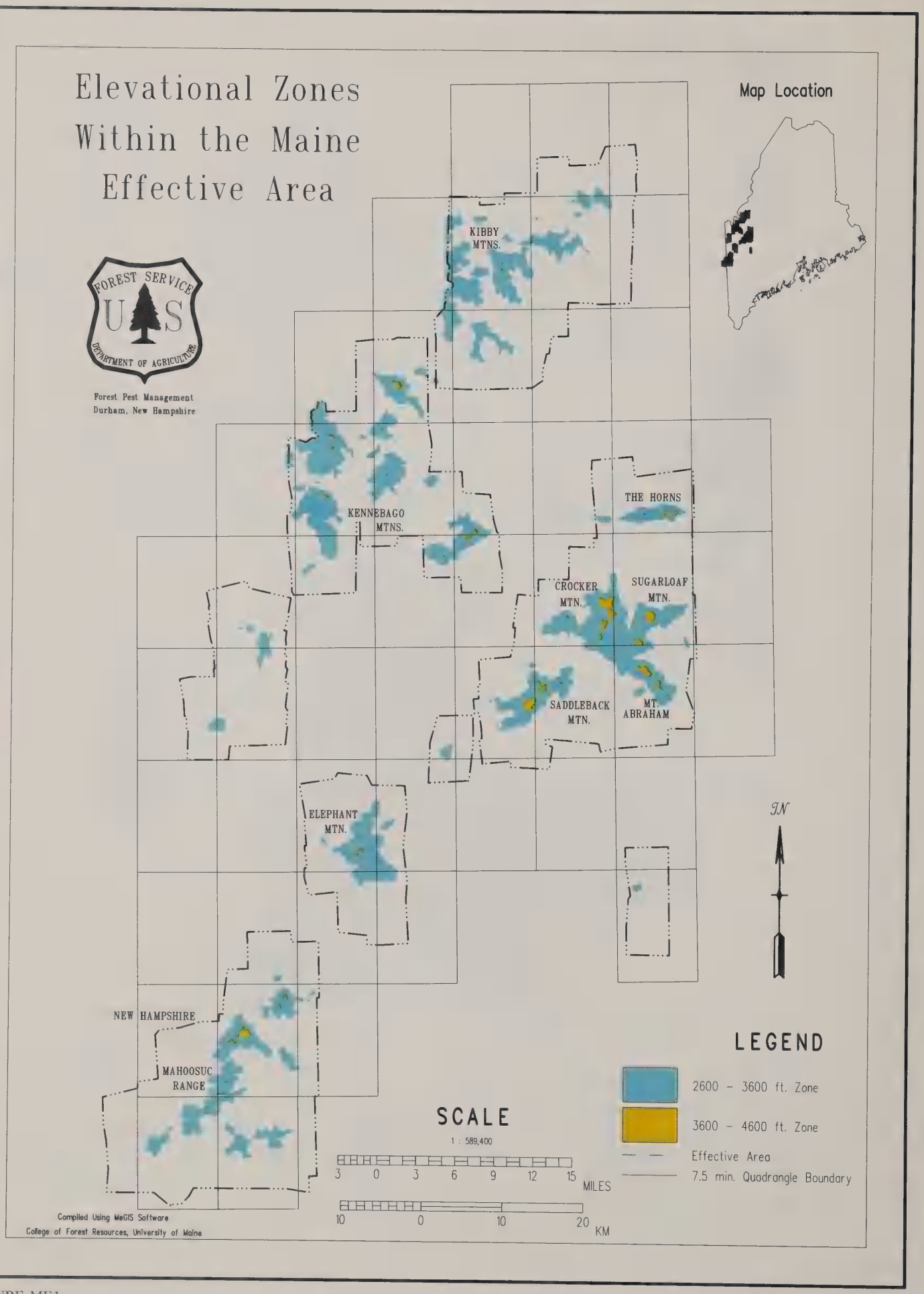

Elevational Zones
Within the Maine
Effective Area
Map Location
FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE
Forest Pest Management
Durham, New Hampshire
KIBBY
MTNS.
KENNEBAGO
MTNS.
THE HORNS
CROCKER
MTN.
SUGARLOAF
MTN.
SADDLEBACK
MTN.
MT.
ABRAHAM
ELEPHANT
MTN.
NEW HAMPSHIRE
MAHOOSUC
RANGE
N
LEGEND
2600 - 3600 ft. Zone
3600 - 4600 ft. Zone
Effective Area
7.5 min. Quadrangle Boundary
SCALE
1 : 589,400
3 0 3 6 9 12 15
MILES
10 0 10 20
KM
Compiled Using MeGIS Software
College of Forest Resources, University of Maine

FIGURE ME1.

MOUNTAINS *of* WESTERN MAINE

The western region of Maine is part of the New England Highlands. The Appalachian Mountain chain begins to spread out here in its northern most extension. These mountains are similar to the White Mountains, having been formed in the same geologic periods; however, they are less rugged and more widely dispersed. The elevation of most of the chain is between 1,000 and 2,000 ft, but there are several peaks above 3,000 ft and a few slightly over 4,000 ft. The gentle, forested slopes that comprise the majority of the area have shallow podzolic soils intermixed with boulders and ledges. The soils in the lower flats commonly are alluvial.

Originally, the developments in this region of Maine centered on forest industry and many small mills; later, the area became popular for recreation. Settlements are found along the major roads, and commercial farmland has been limited to the river valleys of the Androscoggin and its tributaries. There is less development in the remote north where larger industrial woodlands occur. A majority of the area is owned by the forest industry, although there are many small, private ownerships, and some state land. Most of the spruce and fir, which occupy much of the area, has been cut several times.

The vast areas of low elevation spruce-fir forests in northern and eastern portions of Maine, which have been significantly affected by repeated, extensive spruce budworm defoliation, were excluded from this survey. Maine had the smallest area photographed of the four states, yet the largest total area of spruce-fir cover type. Compared to the other states surveyed, the area photographed in Maine extends further north into the natural ranges of spruce and fir where more continuous stands occur at lower elevations.

Maine. Figure ME2 shows the distribution of mortality (standing dead) by cover type and Figure ME3 shows the distribution by elevation. Western Maine had the largest spruce-fir cover type acreage at elevations less than 2,600 ft. Nearly two-thirds of the spruce-fir cover type, within the photographed area in Maine, occurred at these lower elevations. Both the spruce-fir slope and mixedwood occurred mostly at elevations below 2,600 ft, with most of the area classified as spruce-fir slope.

Much harvesting occurs here, which affects the acreages of spruce-fir forest. Some large areas not classified as spruce-fir forest were recent clearcuts. In areas of older clearcuts, dense, young, healthy stands of spruce-fir forest had light mortality. Most of the large clearcuts were salvage operations in areas of heavy mortality caused by impact from the spruce budworm. Unlike the other three regions, some of the photographed area in western Maine was affected by spruce budworm infestations throughout the 1970's and early 1980's (Irland et al. 1988), in combination with secondary factors, resulting in heavy mortality in some stands.

Spruce-fir slope dominated all elevations, however, very little of the spruce-fir forest surveyed in western Maine occurred above 3,600 ft due to limited land area at the higher elevations. Spruce-fir slope exhibited the same distribution of mortality with respect to elevation that was present in the other regions. In the low elevations, the light mortality class was the largest and the heavy mortality class the smallest. At mid elevations, heavy mortality was largest and the proportion of light mortality greatly reduced. At the upper elevations, more than half of the area had heavy mortality. Mixedwood in western Maine occurred only up to 3,600 ft and comprised approximately one-quarter of the spruce-fir area. Most mixedwood had light mortality. The health of mixedwood varied little with elevation.

Spruce-fir swamp accounted for a small portion of the spruce-fir forest in the Maine survey region and almost all was below 2,600 ft.

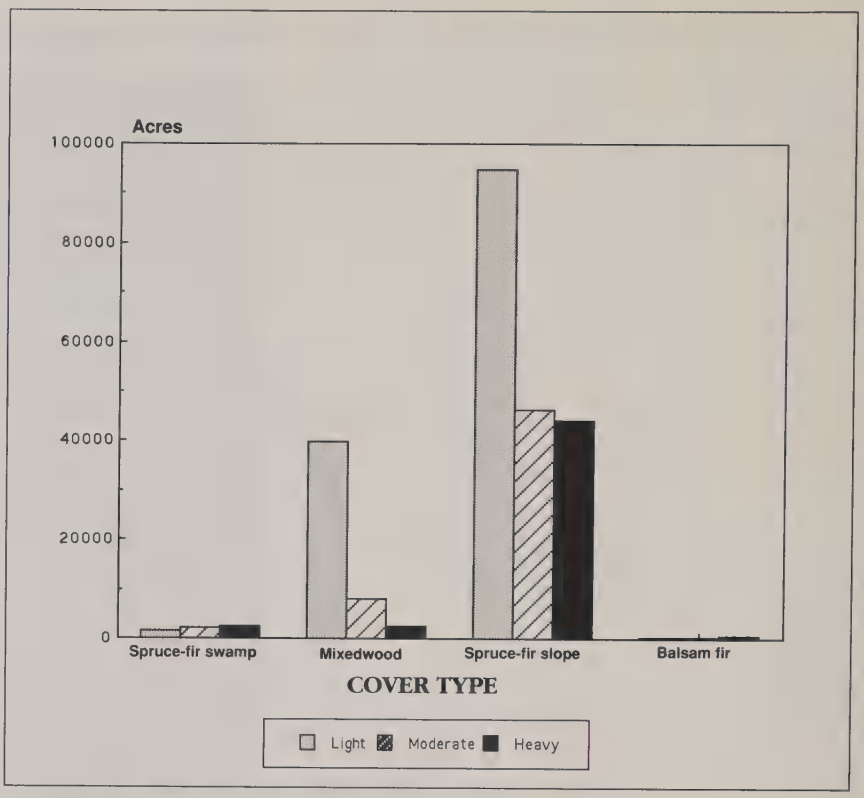


FIGURE ME2.
Distribution of mortality (standing dead) by cover type in the mountains of western Maine.

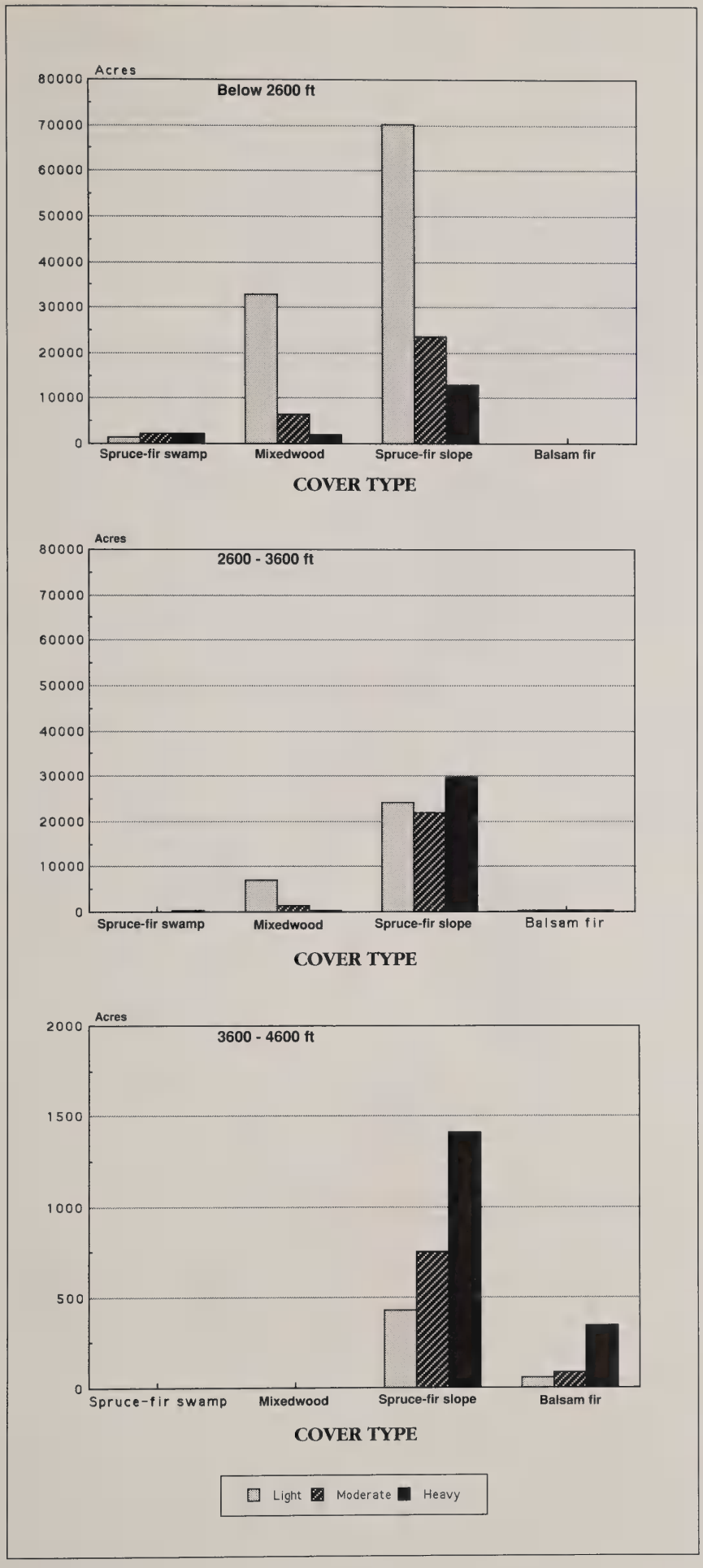


FIGURE ME3.
Distribution of mortality (standing dead) by cover type and elevation in the mountains of western Maine.

One-third of spruce-fir swamp was classified as heavy mortality—a much greater proportion than in the other states. A majority of heavy mortality was in broad flats adjacent to streams and in stands affected by inundation of the root systems. Many of these poorly drained areas result from the physiographic character of western Maine.

Balsam fir occurred between 2,600 and 4,600 ft, with one-third of the type in the higher elevations (3,600-to-4,600 ft). The acreage shown for the balsam fir type in western Maine implies it encompasses a very small area. However, in the aerial photography of this area, it is difficult to distinguish between spruce and fir at lower elevations because there is not a large difference in their relative size and shape. Some of the cover type, which was photointerpreted as spruce-fir slope, may be pure balsam fir type. Most balsam fir had heavy mortality, with a larger proportion at higher elevations. Maine had the highest incidence of fir waves, occurring in an estimated 44 percent of the area with heavy mortality and 19 percent of the moderate mortality area.

Figure ME4 is an index of the twelve mapping units (photo blocks) in western Maine. The Maine summaries are presented by "block" rather than subdivided by "unit", as in the other states. The photographed area in Maine was made up of non-continuous photo blocks which relate directly to the physiography of the region. The acreage summaries presented exclude the western half of Maine Block One, in New Hampshire, and the eastern portion of New Hampshire Unit Two, which is a section of the White Mountain National Forest in Maine. Figures ME5-ME26 display the cover types and mortality in each photo block ❧

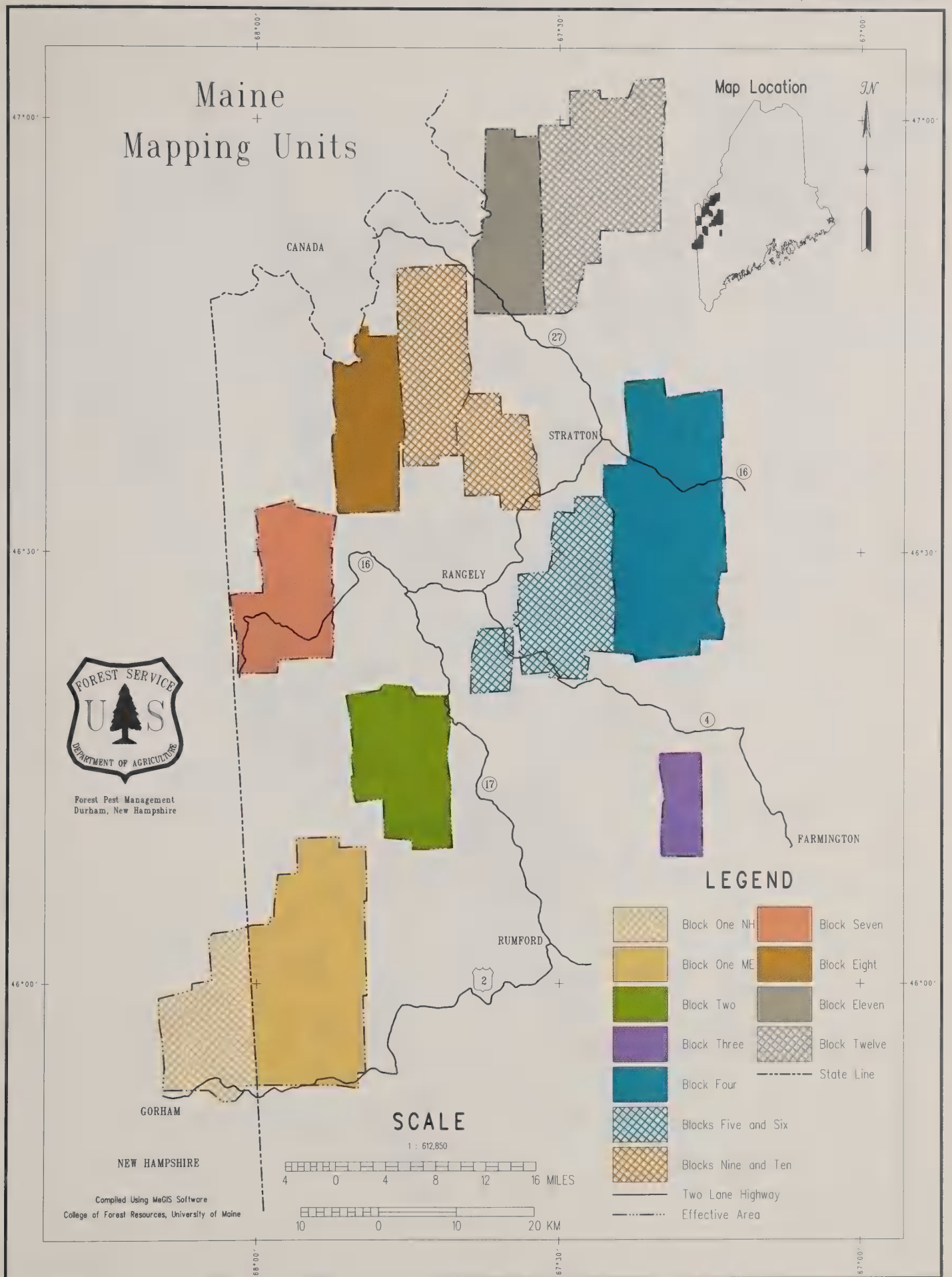

Maine
Mapping Units
Map Location
IN
CANADA
STRATTON
RANGELY
FARMINGTON
RUMFORD
GORHAM
NEW HAMPSHIRE
27
16
16
4
17
2
68°00'
67°30'
67°00'
47°00'
46°30'
46°00'
FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE
Forest Pest Management
Durham, New Hampshire
LEGEND
Block One NH
Block One ME
Block Two
Block Three
Block Four
Blocks Five and Six
Blocks Nine and Ten
Block Seven
Block Eight
Block Eleven
Block Twelve
State Line
Two Lane Highway
Effective Area
SCALE
1 : 612,850
4 0 4 8 12 16 MILES
10 0 10 20 KM
Compiled Using MeGIS Software
College of Forest Resources, University of Maine

FIGURE ME4.

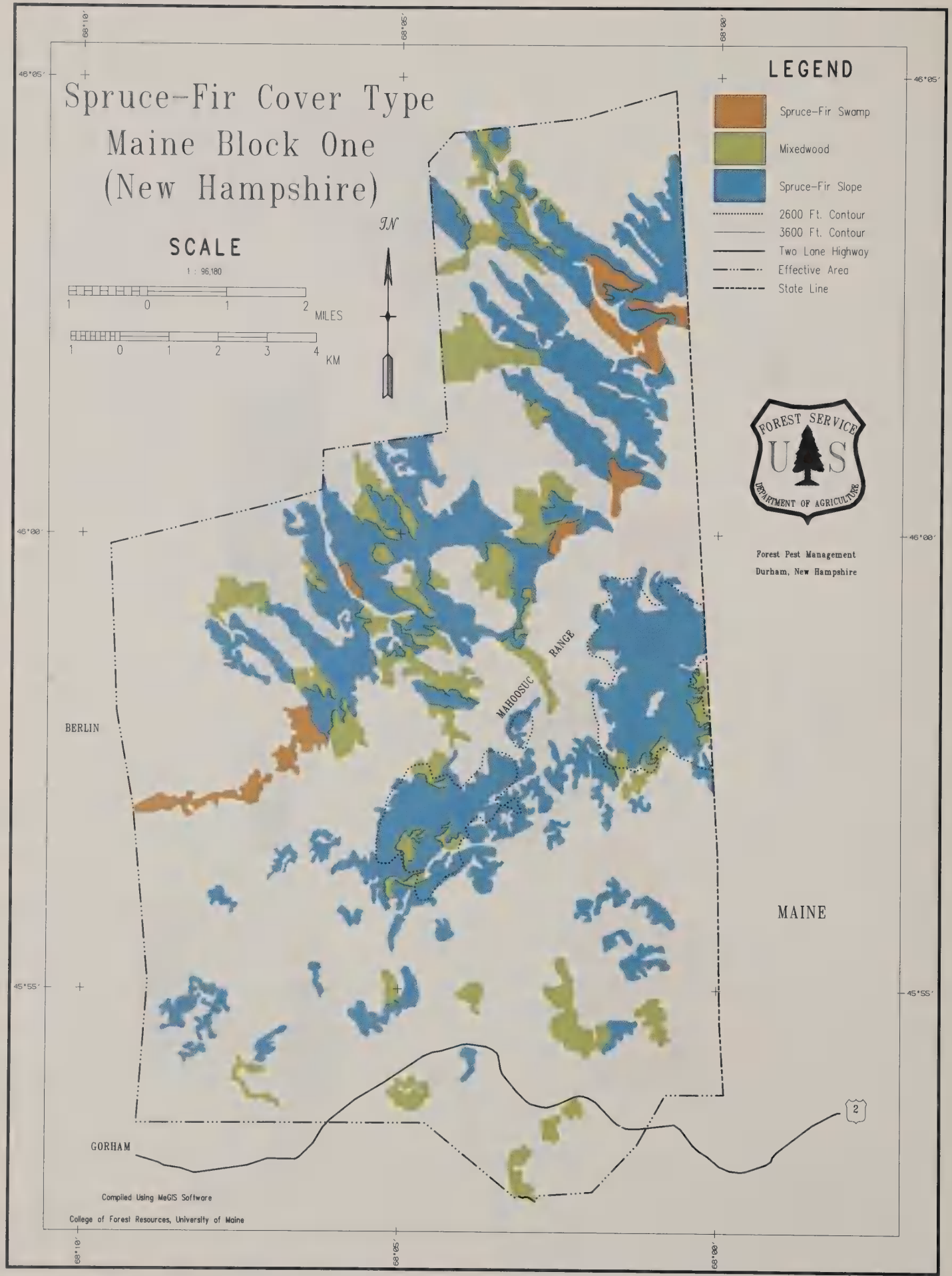

Spruce–Fir Cover Type
Maine Block One
(New Hampshire)
LEGEND
Spruce–Fir Swamp
Mixedwood
Spruce–Fir Slope
2600 Ft. Contour
3600 Ft. Contour
Two Lane Highway
Effective Area
State Line
SCALE
1 : 96,180
1 0 1 2 MILES
1 0 1 2 3 4 KM
FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE
Forest Pest Management
Durham, New Hampshire
MAHOOSUC RANGE
BERLIN
MAINE
GORHAM
2
Compiled Using MeGIS Software
College of Forest Resources, University of Maine
68°10′
68°05′
68°00′
46°05′
46°00′
45°55′

FIGURE ME5.

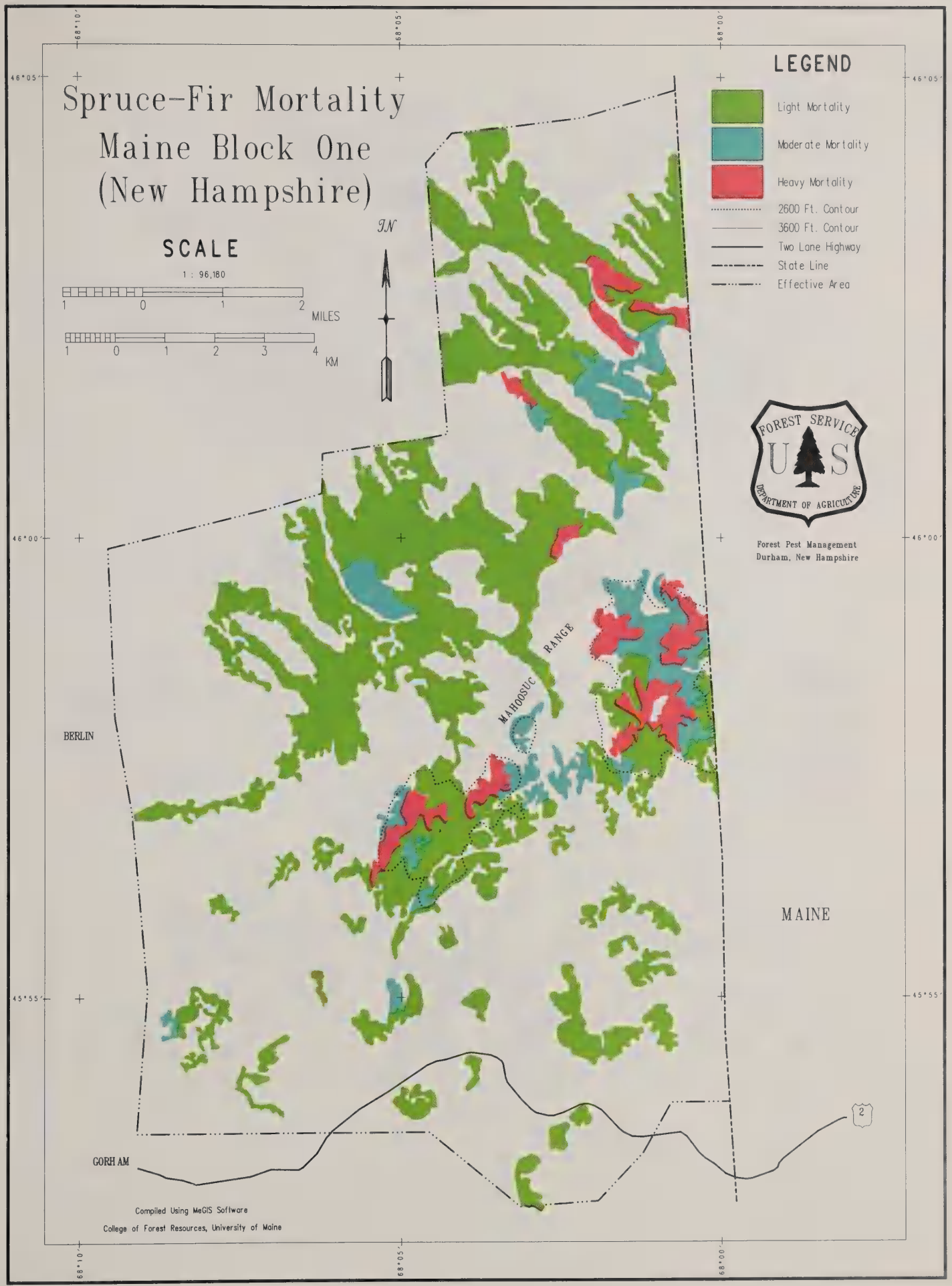

Spruce-Fir Mortality
Maine Block One
(New Hampshire)
SCALE
1 : 96,180
1 0 1 2
MILES
1 0 1 2 3 4
KM
N
LEGEND
Light Mortality
Moderate Mortality
Heavy Mortality
2600 Ft. Contour
3600 Ft. Contour
Two Lane Highway
State Line
Effective Area
FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE
Forest Pest Management
Durham, New Hampshire
MAHOOSUC RANGE
BERLIN
MAINE
GORHAM
2
Compiled Using MeGIS Software
College of Forest Resources, University of Maine
46°05'
46°00'
45°55'
68°10'
68°05'
68°00'

FIGURE ME6.

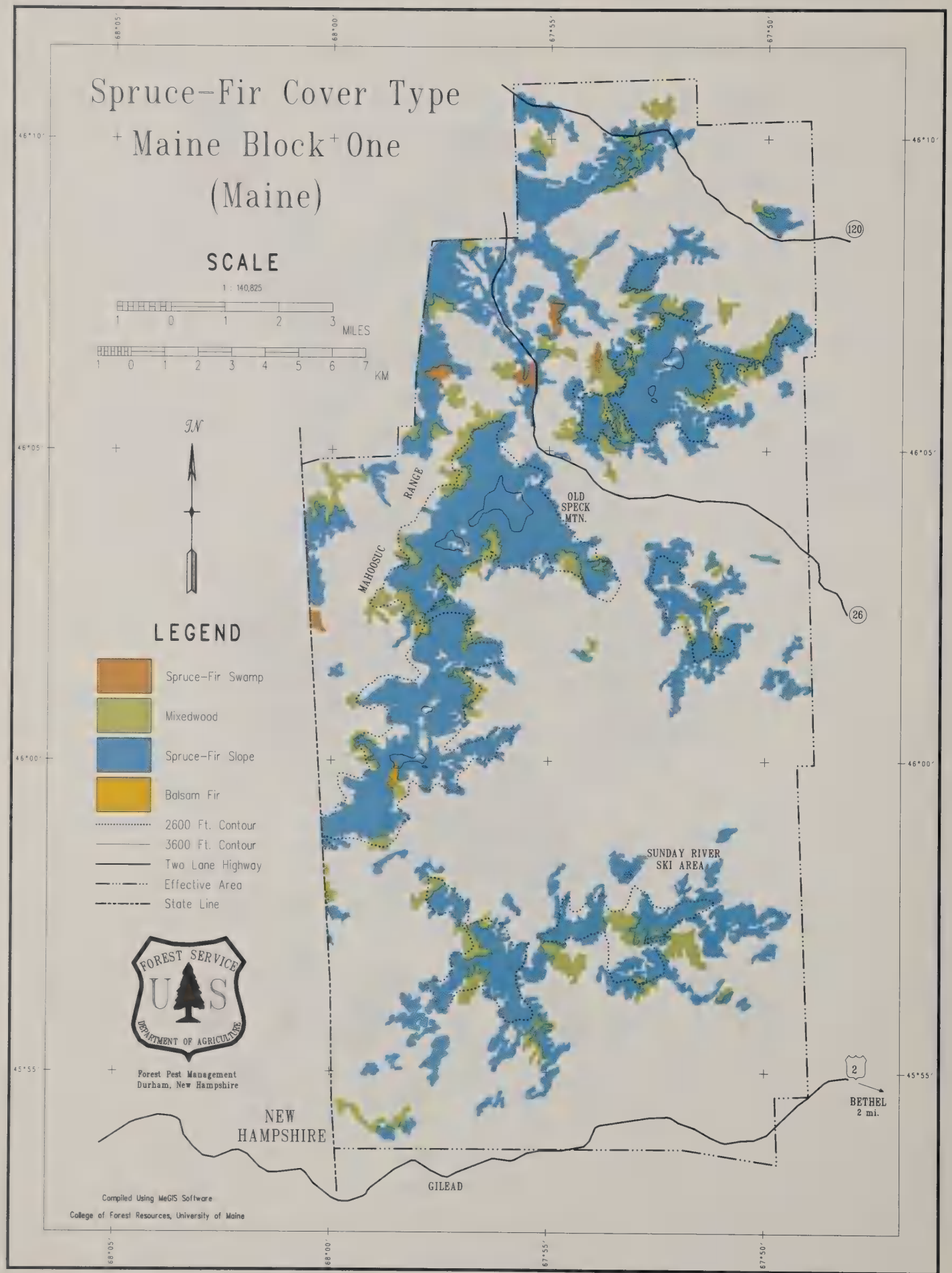

Spruce–Fir Cover Type
Maine Block One
(Maine)
SCALE
1 : 140,825
1 0 1 2 3 MILES
1 0 1 2 3 4 5 6 7 KM
N
LEGEND
Spruce–Fir Swamp
Mixedwood
Spruce–Fir Slope
Balsam Fir
2600 Ft. Contour
3600 Ft. Contour
Two Lane Highway
Effective Area
State Line
FOREST SERVICE
US
DEPARTMENT OF AGRICULTURE
Forest Pest Management
Durham, New Hampshire
Compiled Using MeGIS Software
College of Forest Resources, University of Maine
RANGE
MAHOOSUC
OLD SPECK MTN.
SUNDAY RIVER SKI AREA
NEW HAMPSHIRE
GILEAD
BETHEL 2 mi.
120
26
2
68°05'
68°00'
67°55'
67°50'
46°10'
46°05'
46°00'
45°55'

FIGURE ME7.

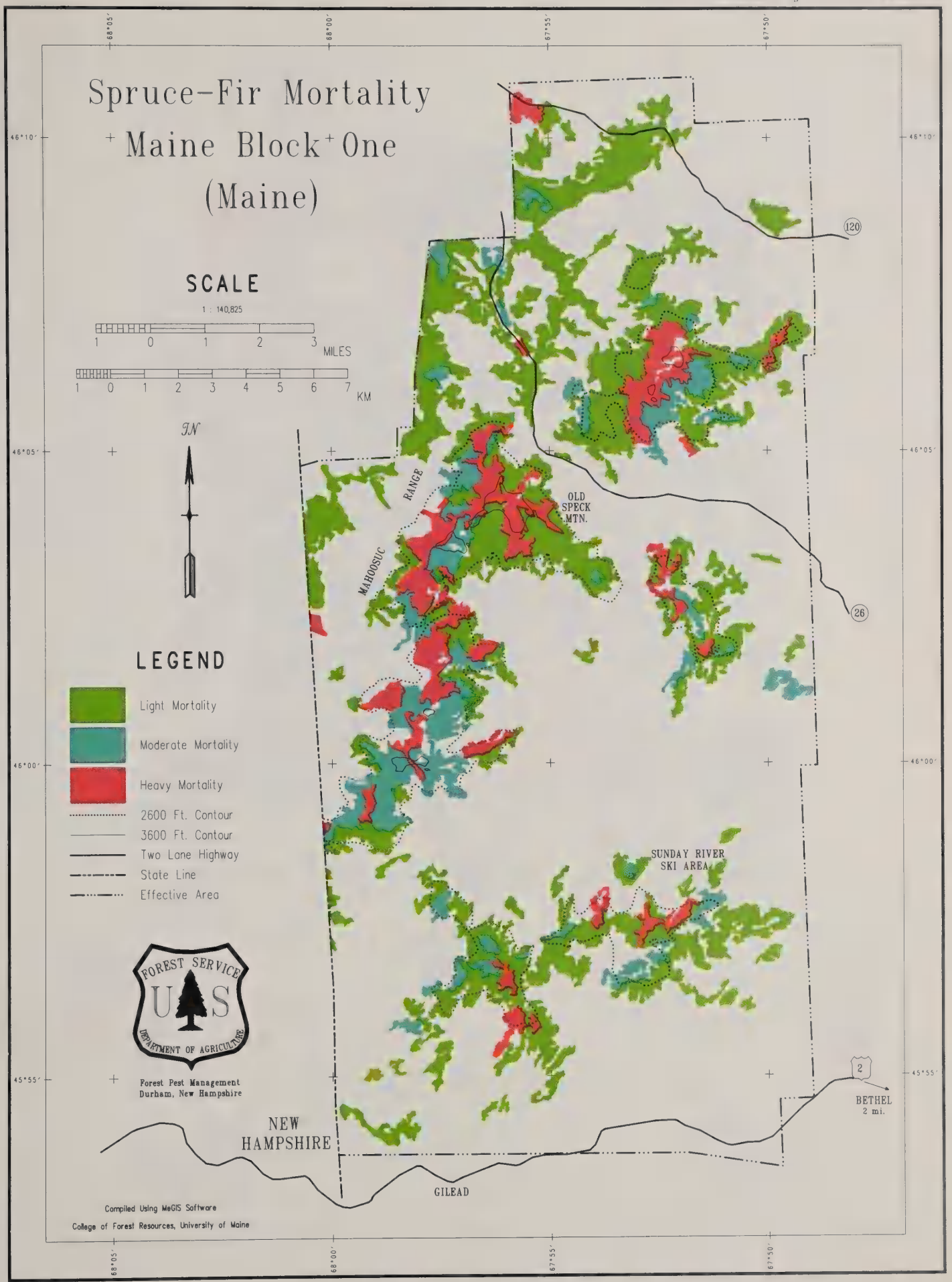

Spruce-Fir Mortality
+ Maine Block + One
(Maine)
SCALE
1 : 140,825
1 0 1 2 3 MILES
1 0 1 2 3 4 5 6 7 KM
N
LEGEND
Light Mortality
Moderate Mortality
Heavy Mortality
2600 Ft. Contour
3600 Ft. Contour
Two Lane Highway
State Line
Effective Area
FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE
Forest Pest Management
Durham, New Hampshire
Compiled Using MeGIS Software
College of Forest Resources, University of Maine
RANGE
MAHOOSUC
OLD SPECK MTN.
SUNDAY RIVER SKI AREA
NEW HAMPSHIRE
GILEAD
BETHEL
2 mi.
120
26
2
68°05'
68°00'
67°55'
67°50'
46°10'
46°05'
46°00'
45°55'

FIGURE ME8.

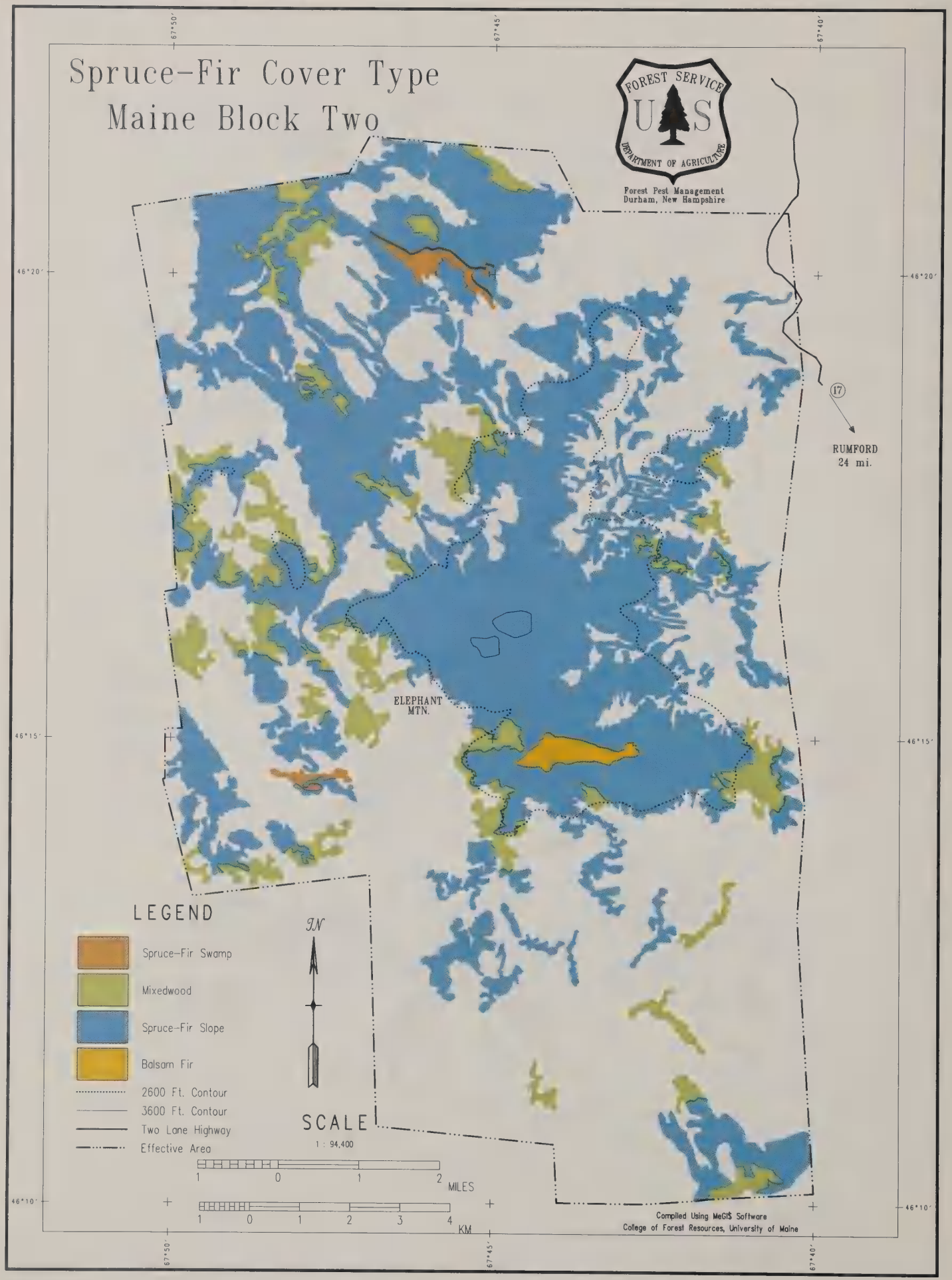

Spruce–Fir Cover Type
Maine Block Two
FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE
Forest Pest Management
Durham, New Hampshire
67°50'
67°45'
67°40'
46°20'
46°15'
46°10'
17
RUMFORD
24 mi.
ELEPHANT
MTN.
LEGEND
Spruce–Fir Swamp
Mixedwood
Spruce–Fir Slope
Balsam Fir
2600 Ft. Contour
3600 Ft. Contour
Two Lane Highway
Effective Area
IN
SCALE
1 : 94,400
1 0 1 2 MILES
1 0 1 2 3 4 KM
Compiled Using MeGIS Software
College of Forest Resources, University of Maine

FIGURE ME9.

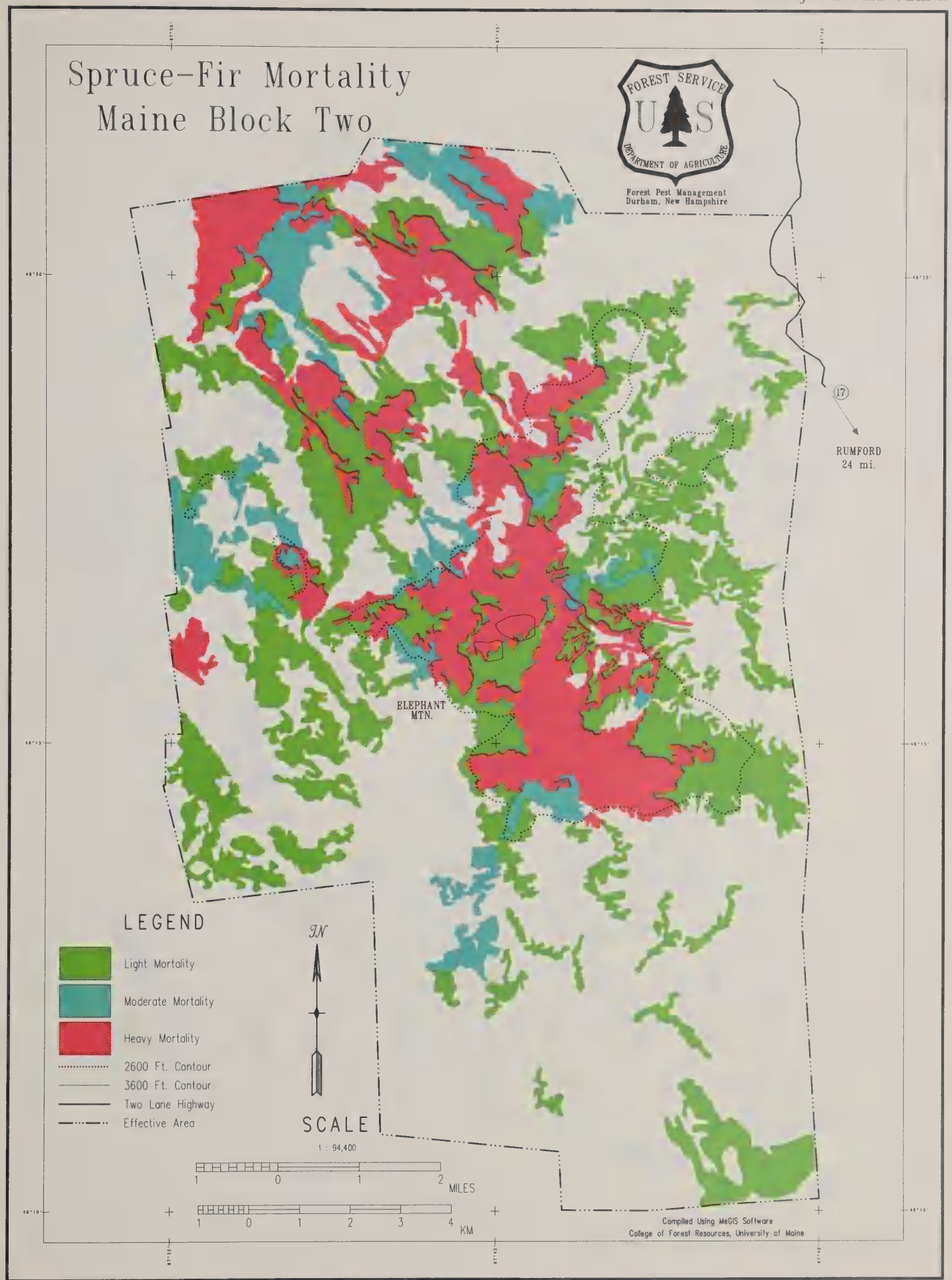

Spruce-Fir Mortality
Maine Block Two
FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE
Forest Pest Management
Durham, New Hampshire
17
RUMFORD
24 mi.
ELEPHANT
MTN.
LEGEND
Light Mortality
Moderate Mortality
Heavy Mortality
2600 Ft. Contour
3600 Ft. Contour
Two Lane Highway
Effective Area
N
SCALE
1 : 94,400
1 0 1 2 MILES
1 0 1 2 3 4 KM
Compiled Using MeGIS Software
College of Forest Resources, University of Maine

FIGURE ME10.

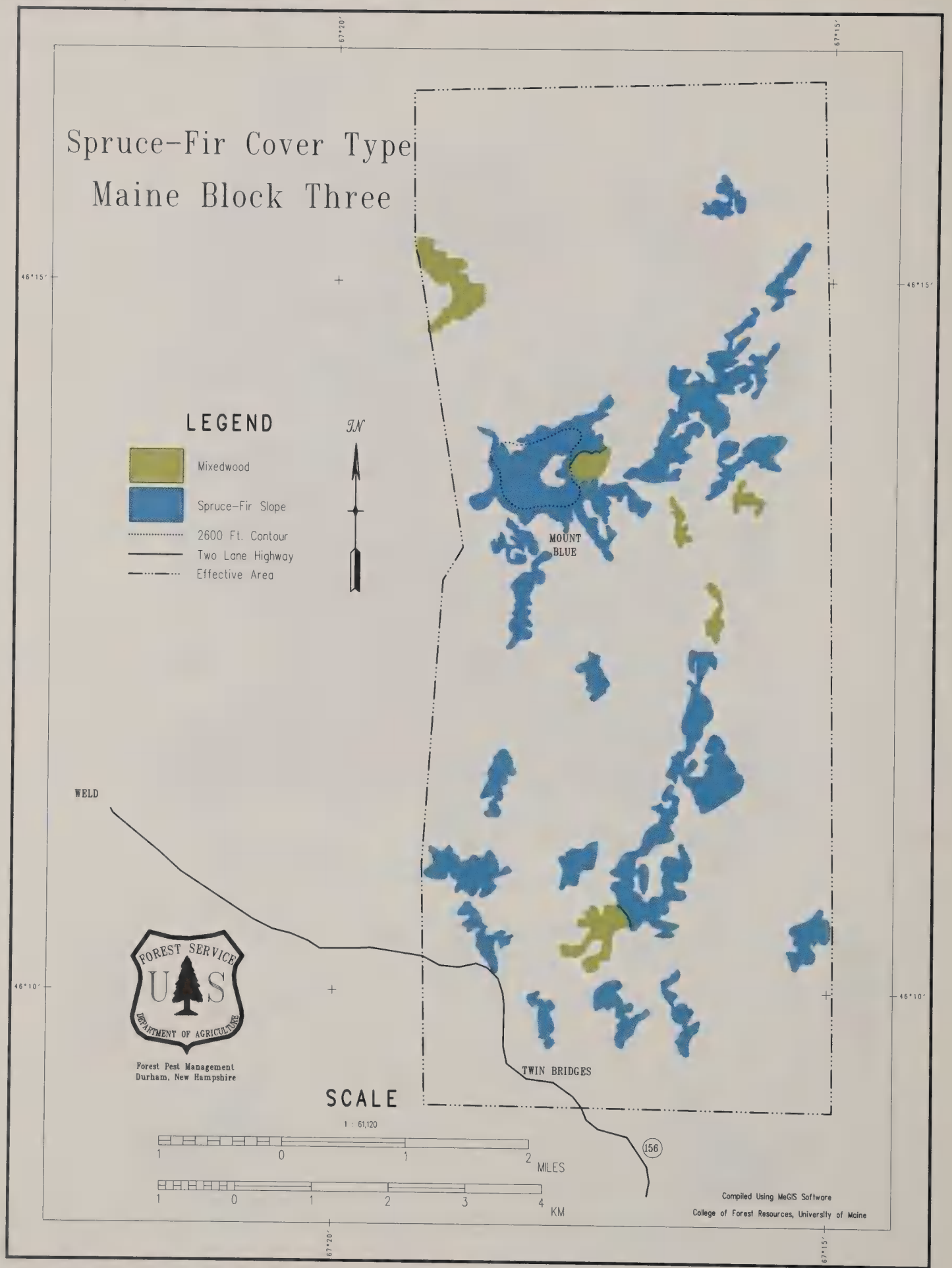

Spruce-Fir Cover Type
Maine Block Three
67°20'
67°15'
46°15'
46°10'
LEGEND
Mixedwood
Spruce-Fir Slope
2600 Ft. Contour
Two Lane Highway
Effective Area
N
MOUNT BLUE
WELD
TWIN BRIDGES
156
FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE
Forest Pest Management
Durham, New Hampshire
SCALE
1 : 61,120
1 0 1 2 MILES
1 0 1 2 3 4 KM
Compiled Using MeGIS Software
College of Forest Resources, University of Maine

FIGURE ME11.

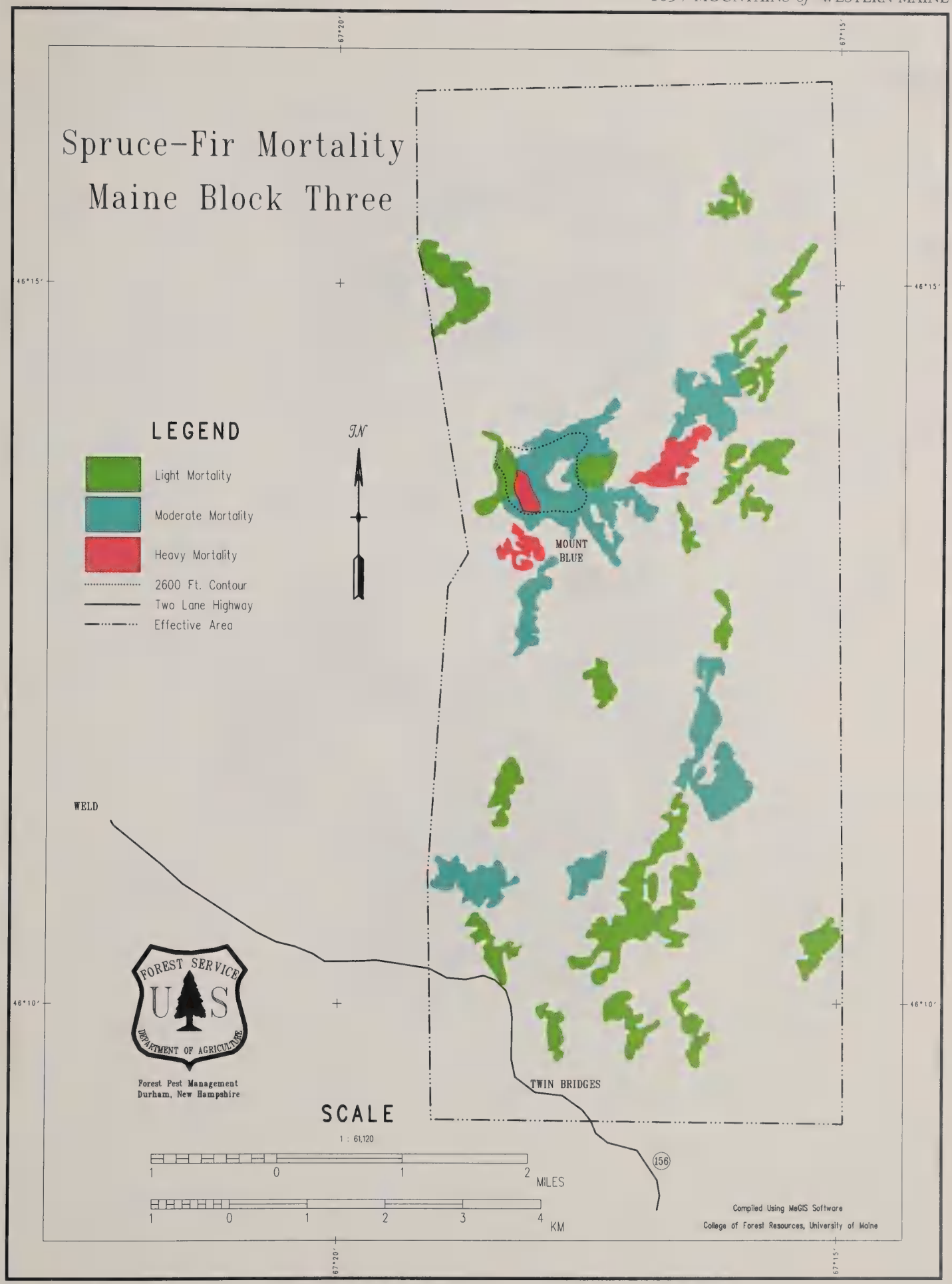

Spruce-Fir Mortality
Maine Block Three
LEGEND
Light Mortality
Moderate Mortality
Heavy Mortality
2600 Ft. Contour
Two Lane Highway
Effective Area
N
MOUNT BLUE
WELD
TWIN BRIDGES
156
FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE
Forest Pest Management
Durham, New Hampshire
SCALE
1 : 61,120
1 0 1 2 MILES
1 0 1 2 3 4 KM
Compiled Using MeGIS Software
College of Forest Resources, University of Maine
67°20'
67°15'
46°15'
46°10'

FIGURE ME12.

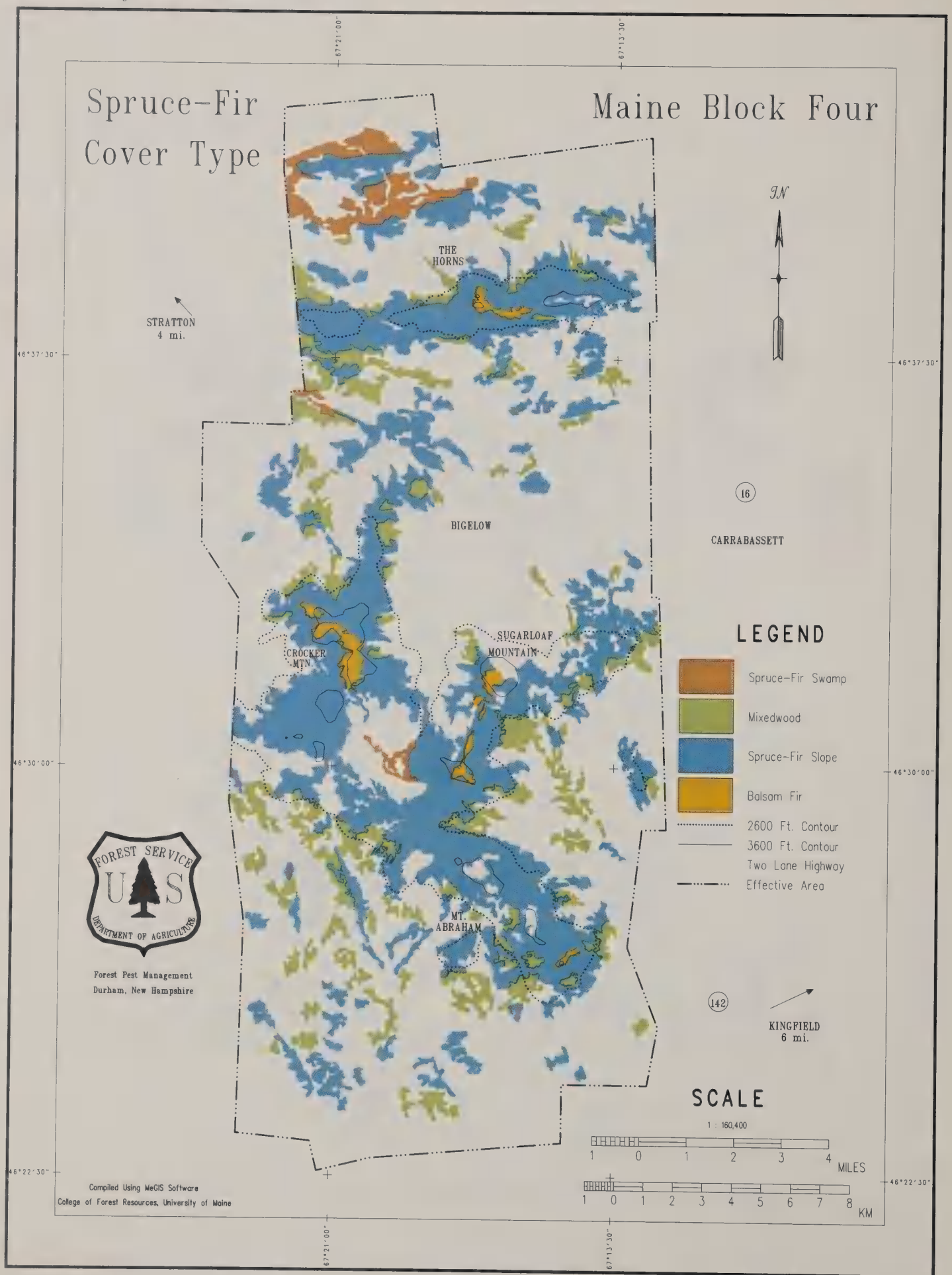

Spruce-Fir
Cover Type
Maine Block Four
67°21'00"
67°13'30"
46°37'30"
46°30'00"
46°22'30"
N
THE
HORNS
STRATTON
4 mi.
BIGELOW
16
CARRABASSETT
SUGARLOAF
MOUNTAIN
CROCKER
MTN.
MT.
ABRAHAM
142
KINGFIELD
6 mi.
LEGEND
Spruce-Fir Swamp
Mixedwood
Spruce-Fir Slope
Balsam Fir
2600 Ft. Contour
3600 Ft. Contour
Two Lane Highway
Effective Area
SCALE
1 : 160,400
1 0 1 2 3 4 MILES
1 0 1 2 3 4 5 6 7 8 KM
FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE
Forest Pest Management
Durham, New Hampshire
Compiled Using MeGIS Software
College of Forest Resources, University of Maine

FIGURE ME13.

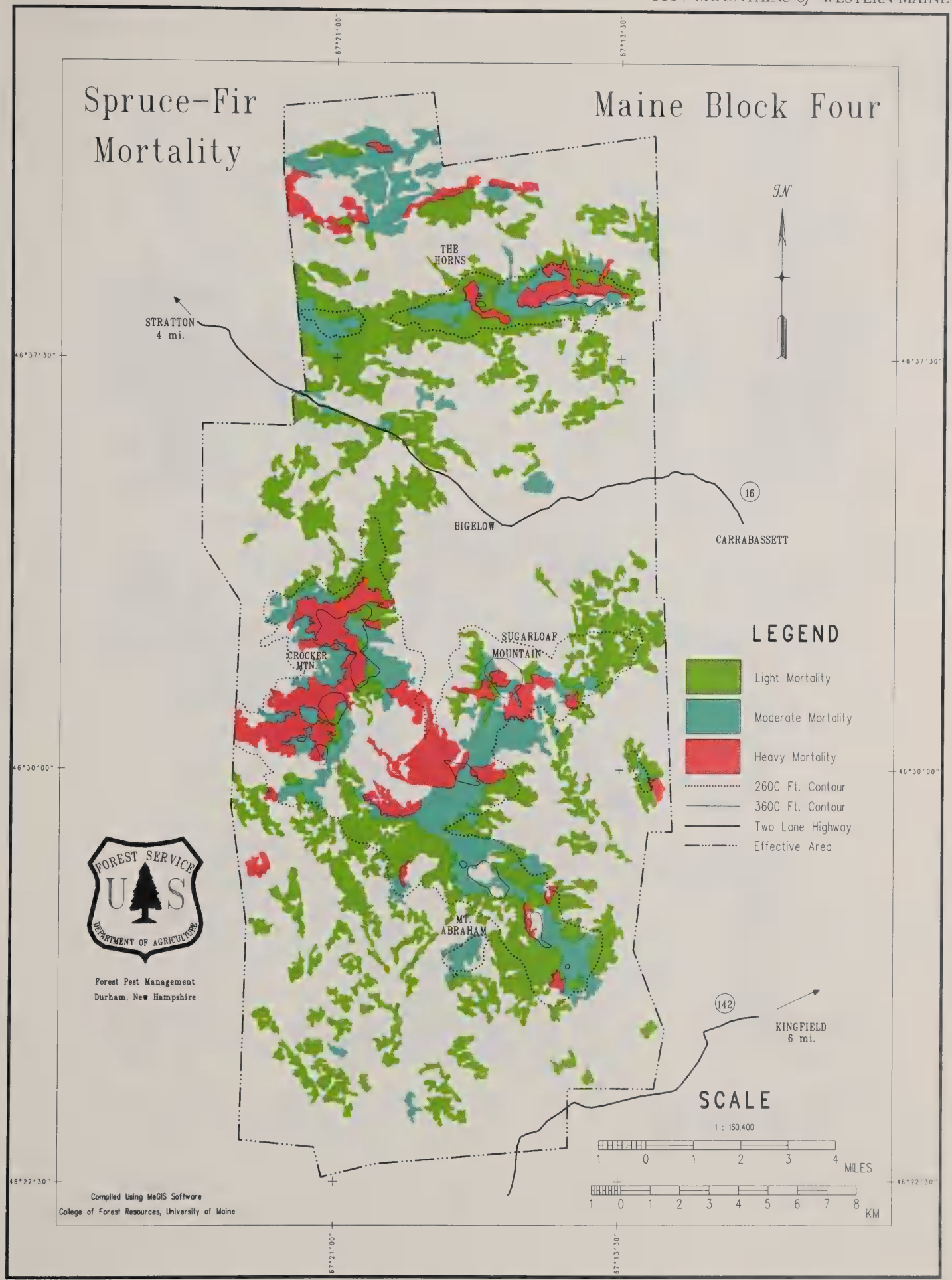

Spruce-Fir Mortality
Maine Block Four
THE HORNS
STRATTON 4 mi.
BIGELOW
CARRABASSETT
16
SUGARLOAF MOUNTAIN
CROCKER MTN.
MT. ABRAHAM
142
KINGFIELD 6 mi.
LEGEND
Light Mortality
Moderate Mortality
Heavy Mortality
2600 Ft. Contour
3600 Ft. Contour
Two Lane Highway
Effective Area
SCALE
1 : 160,400
MILES
KM
FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE
Forest Pest Management
Durham, New Hampshire
Compiled Using MeGIS Software
College of Forest Resources, University of Maine
67°21'00"
67°13'30"
46°37'30"
46°30'00"
46°22'30"

FIGURE ME14.

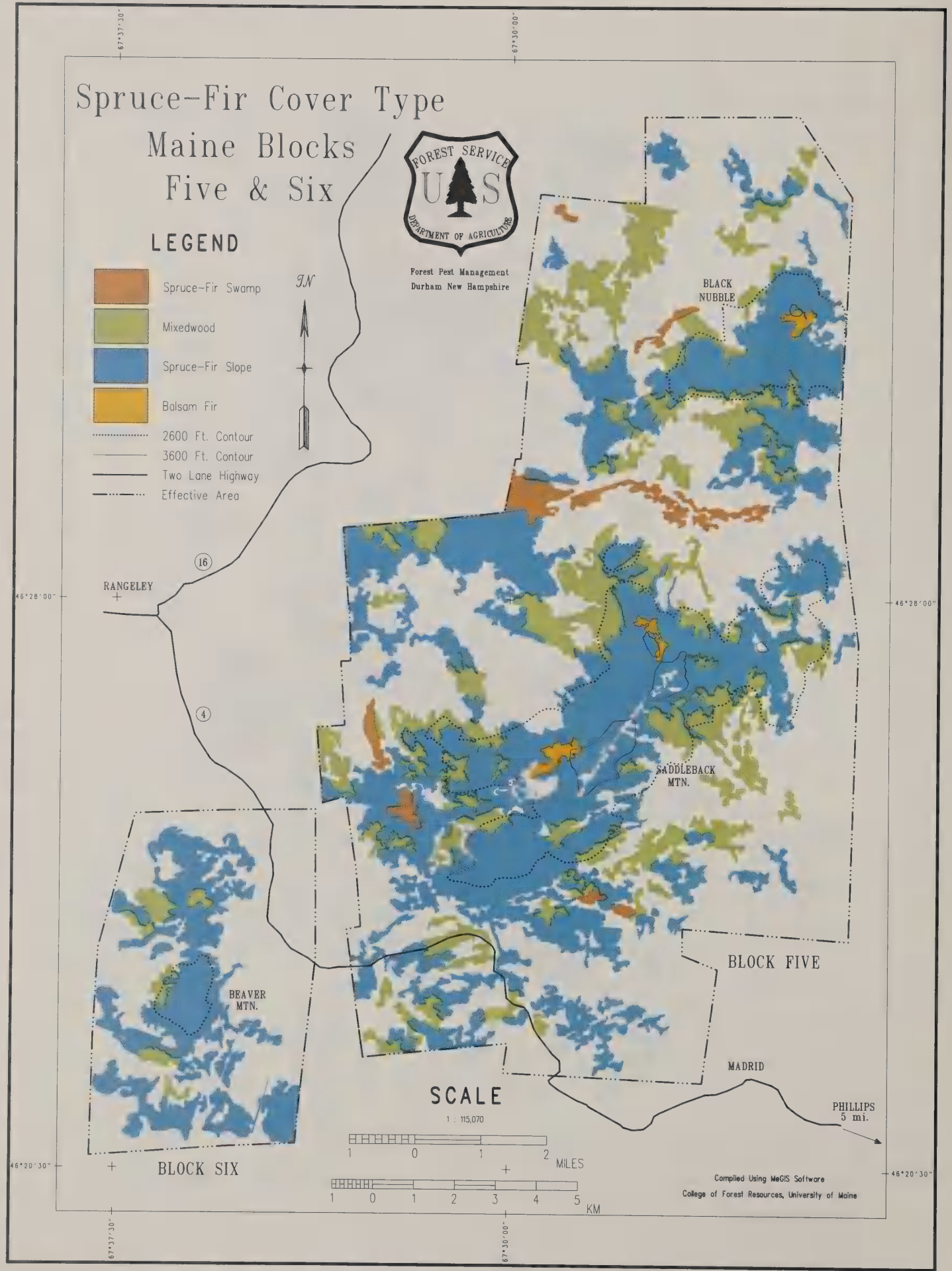

Spruce-Fir Cover Type
Maine Blocks
Five & Six
FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE
Forest Pest Management
Durham New Hampshire
LEGEND
Spruce-Fir Swamp
Mixedwood
Spruce-Fir Slope
Balsam Fir
2600 Ft. Contour
3600 Ft. Contour
Two Lane Highway
Effective Area
IN
67°37'30"
67°30'00"
46°28'00"
46°20'30"
16
4
RANGELEY
BLACK
NUBBLE
SADDLEBACK
MTN.
BEAVER
MTN.
BLOCK FIVE
BLOCK SIX
MADRID
PHILLIPS
5 mi.
SCALE
1 : 115,070
1 0 1 2 MILES
1 0 1 2 3 4 5 KM
Compiled Using MeGIS Software
College of Forest Resources, University of Maine

FIGURE ME15.

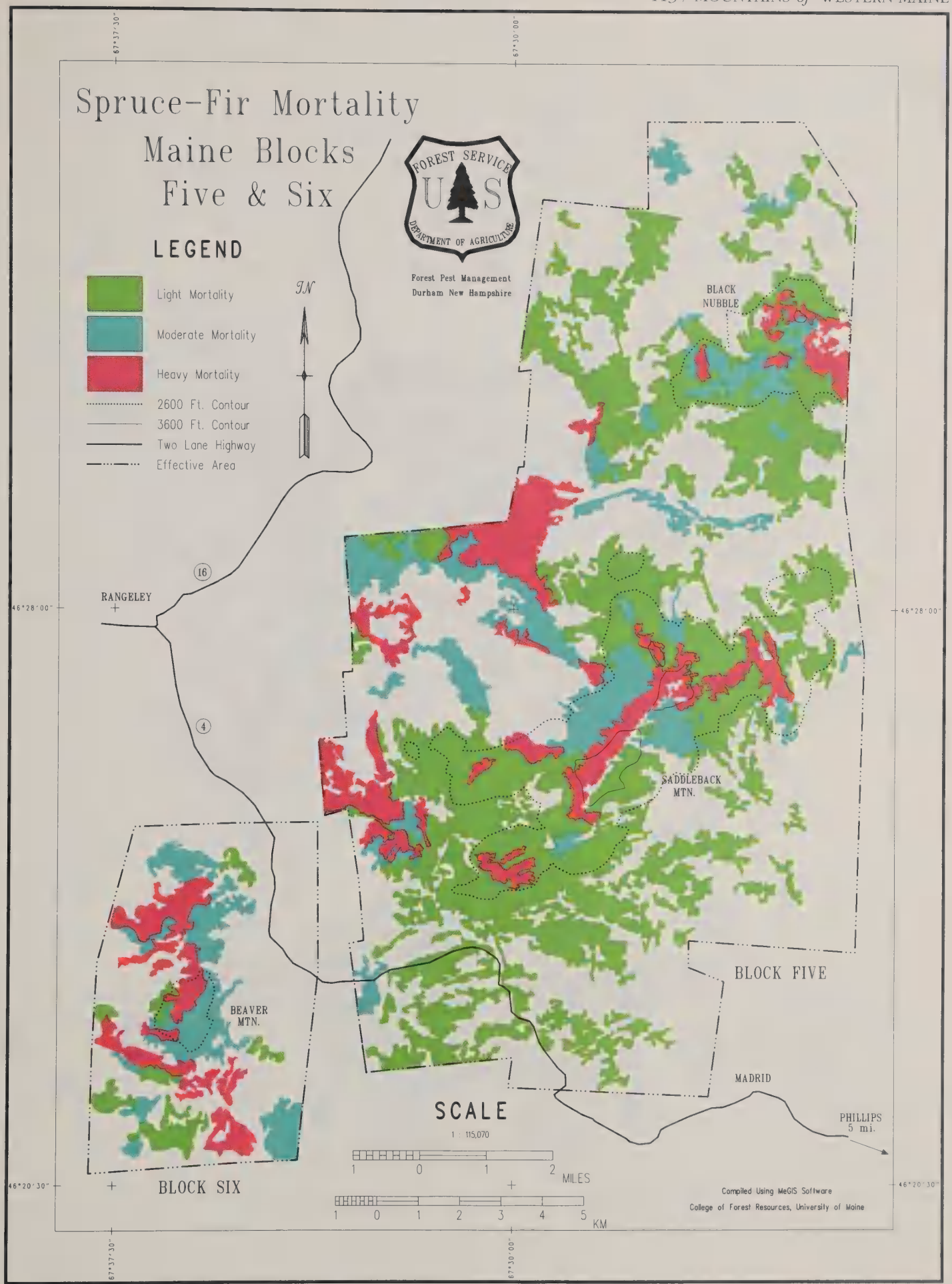

Spruce-Fir Mortality
Maine Blocks
Five & Six
FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE
Forest Pest Management
Durham New Hampshire
LEGEND
Light Mortality
Moderate Mortality
Heavy Mortality
2600 Ft. Contour
3600 Ft. Contour
Two Lane Highway
Effective Area
N
BLACK
NUBBLE
RANGELEY
16
4
SADDLEBACK
MTN.
BEAVER
MTN.
BLOCK FIVE
BLOCK SIX
MADRID
PHILLIPS
5 mi.
SCALE
1 : 115,070
1 0 1 2 MILES
1 0 1 2 3 4 5 KM
Compiled Using MeGIS Software
College of Forest Resources, University of Maine
67°37'30"
67°30'00"
46°28'00"
46°20'30"

FIGURE ME16.

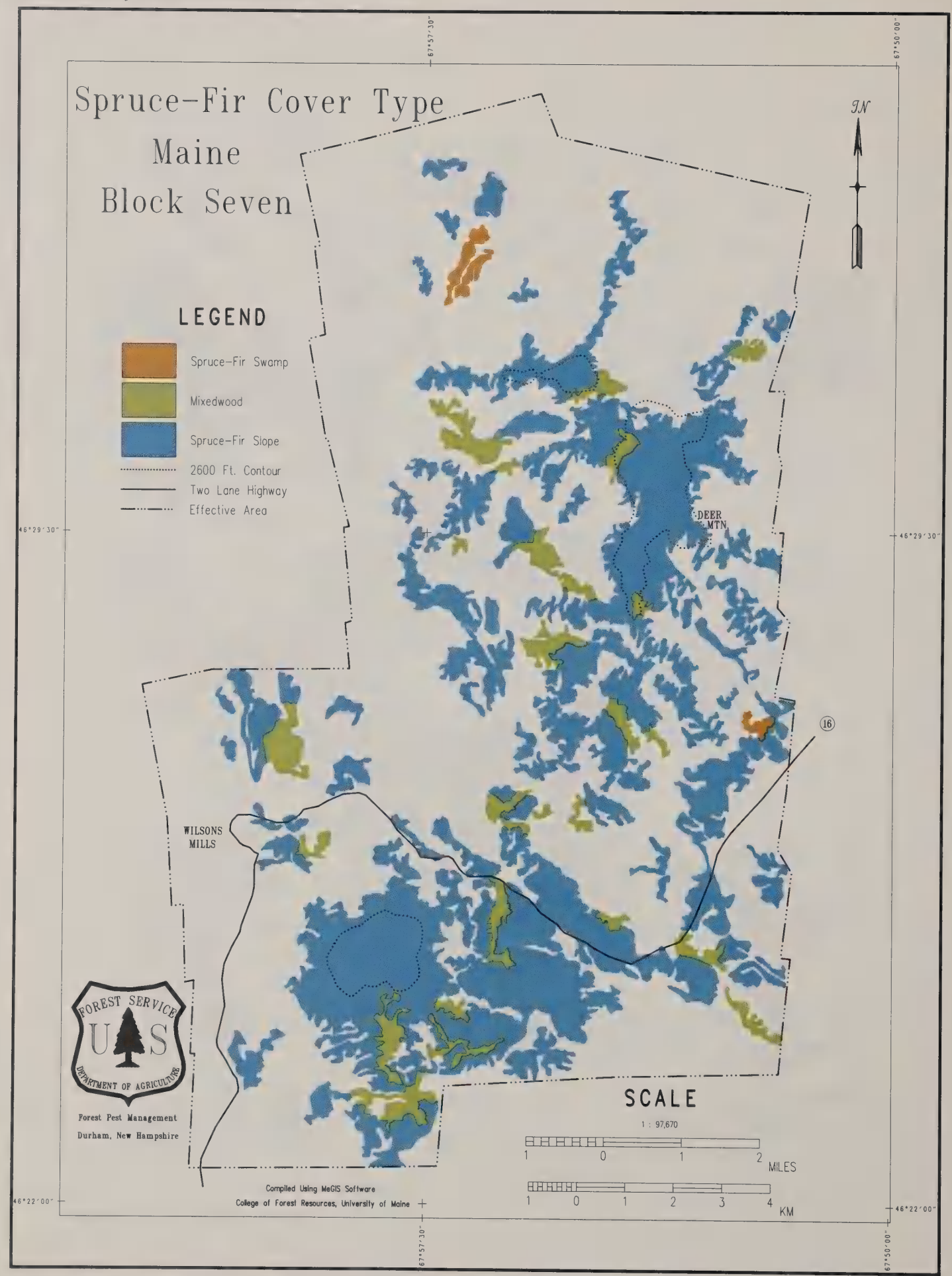

Spruce-Fir Cover Type
Maine
Block Seven
LEGEND
Spruce-Fir Swamp
Mixedwood
Spruce-Fir Slope
2600 Ft. Contour
Two Lane Highway
Effective Area
DEER MTN.
WILSONS MILLS
16
FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE
Forest Pest Management
Durham, New Hampshire
Compiled Using MeGIS Software
College of Forest Resources, University of Maine
SCALE
1 : 97,670
1 0 1 2 MILES
1 0 1 2 3 4 KM
67°57'30"
67°50'00"
46°29'30"
46°22'00"

FIGURE ME17.

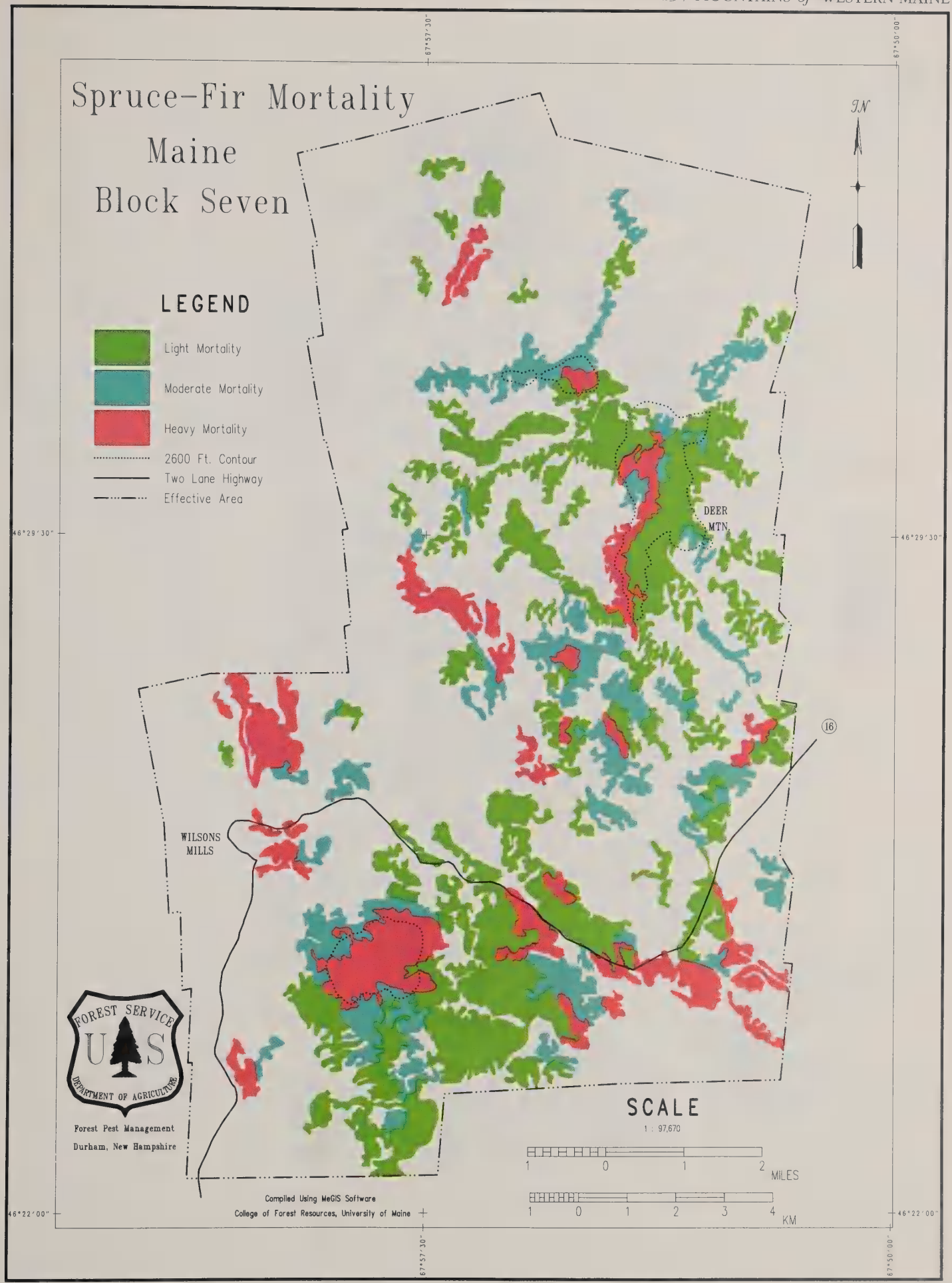

Spruce-Fir Mortality
Maine
Block Seven
LEGEND
Light Mortality
Moderate Mortality
Heavy Mortality
2600 Ft. Contour
Two Lane Highway
Effective Area
IN
DEER MTN.
WILSONS MILLS
16
67°57'30"
67°50'00"
46°29'30"
46°22'00"
FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE
Forest Pest Management
Durham, New Hampshire
Compiled Using MeGIS Software
College of Forest Resources, University of Maine
SCALE
1 : 97,670
1 0 1 2 MILES
1 0 1 2 3 4 KM

FIGURE ME18.

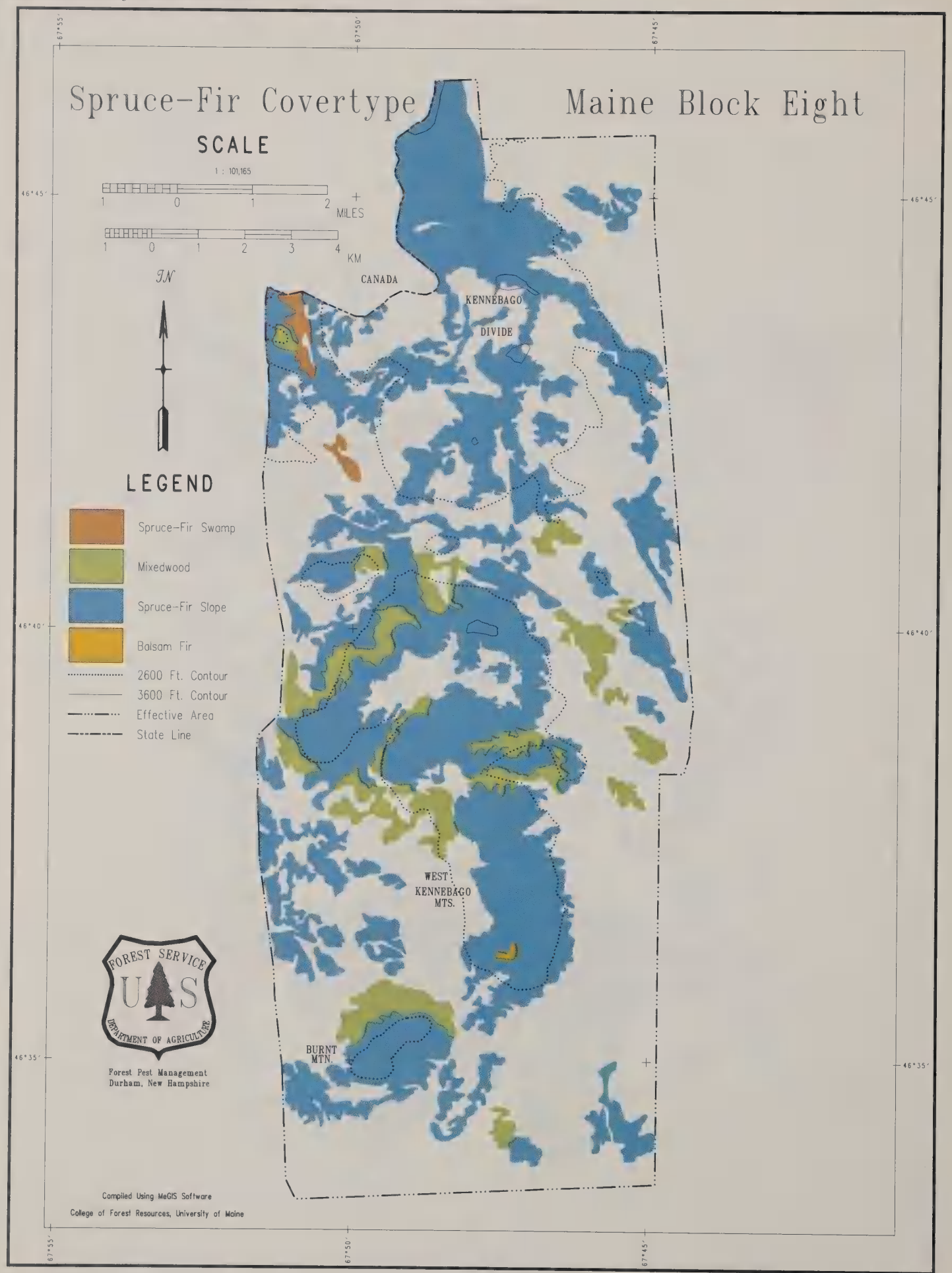

Spruce-Fir Covertype
Maine Block Eight
SCALE
1 : 101,165
1 0 1 2 MILES
1 0 1 2 3 4 KM
N
CANADA
KENNEBAGO DIVIDE
WEST KENNEBAGO MTS.
BURNT MTN.
LEGEND
Spruce-Fir Swamp
Mixedwood
Spruce-Fir Slope
Balsam Fir
2600 Ft. Contour
3600 Ft. Contour
Effective Area
State Line
FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE
Forest Pest Management
Durham, New Hampshire
Compiled Using MeGIS Software
College of Forest Resources, University of Maine
67°55'
67°50'
67°45'
46°45'
46°40'
46°35'

FIGURE ME19.

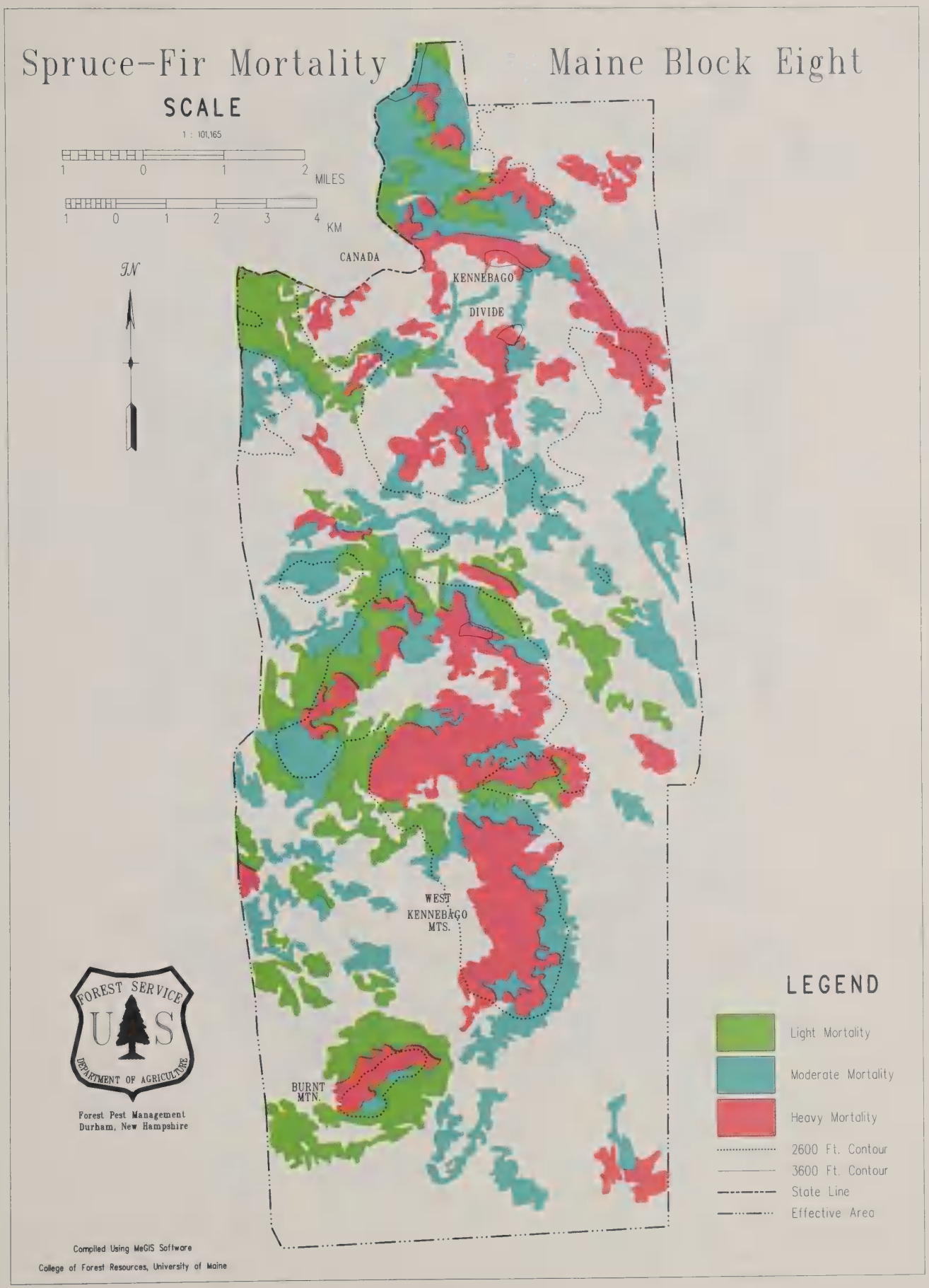

Spruce-Fir Mortality
Maine Block Eight
SCALE
1 : 101,165
1 0 1 2 MILES
1 0 1 2 3 4 KM
IN
CANADA
KENNEBAGO
DIVIDE
WEST
KENNEBAGO
MTS.
BURNT
MTN.
FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE
Forest Pest Management
Durham, New Hampshire
Compiled Using MeGIS Software
College of Forest Resources, University of Maine
LEGEND
Light Mortality
Moderate Mortality
Heavy Mortality
2600 Ft. Contour
3600 Ft. Contour
State Line
Effective Area

FIGURE ME20.

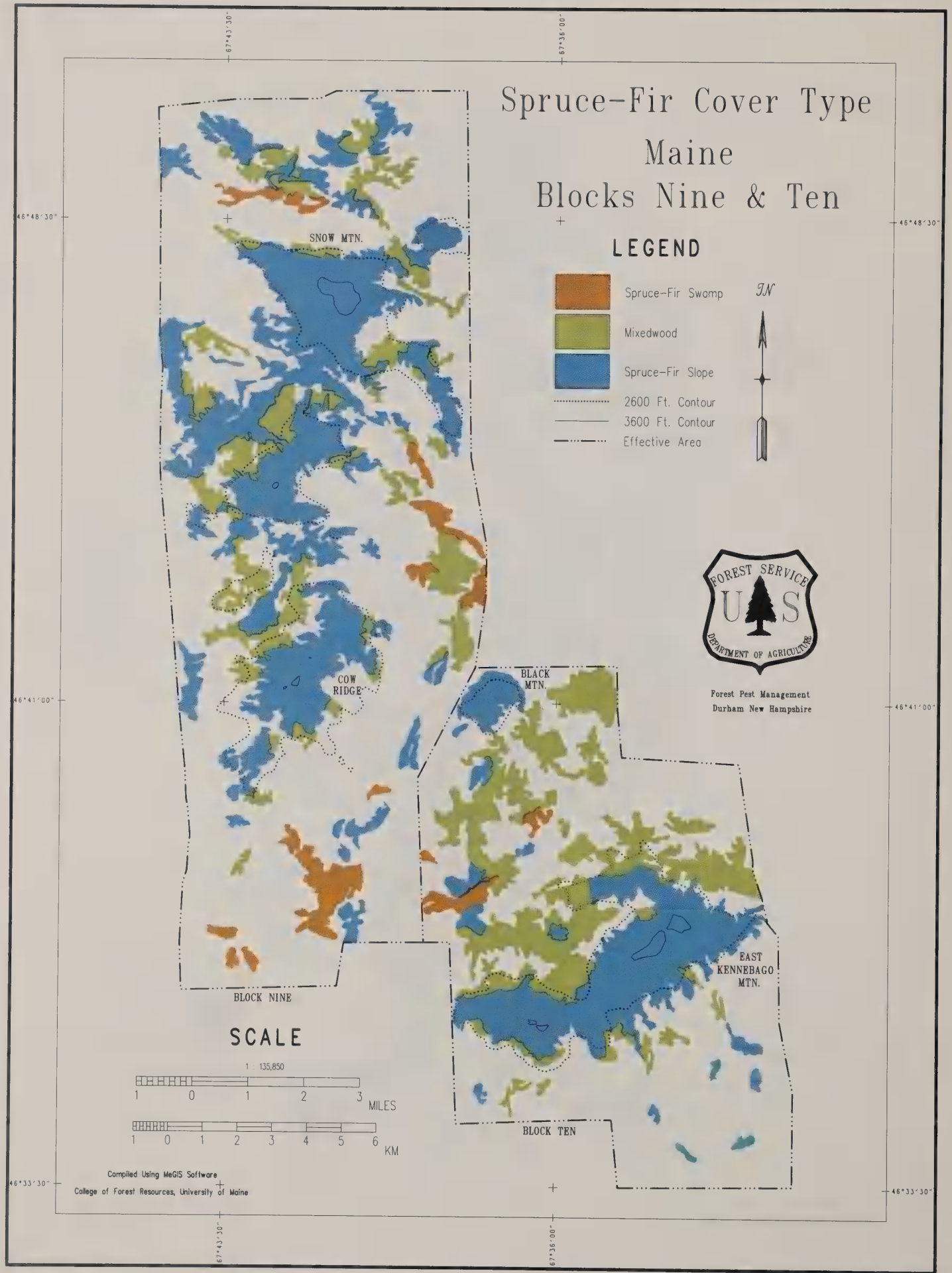

Spruce-Fir Cover Type
Maine
Blocks Nine & Ten
LEGEND
Spruce-Fir Swamp
Mixedwood
Spruce-Fir Slope
2600 Ft. Contour
3600 Ft. Contour
Effective Area
IN
SNOW MTN.
COW RIDGE
BLACK MTN.
EAST KENNEBAGO MTN.
BLOCK NINE
BLOCK TEN
FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE
Forest Pest Management
Durham New Hampshire
SCALE
1 : 135,850
1 0 1 2 3 MILES
1 0 1 2 3 4 5 6 KM
Compiled Using MeGIS Software
College of Forest Resources, University of Maine
67°43'30"
67°36'00"
46°48'30"
46°41'00"
46°33'30"

FIGURE ME21.

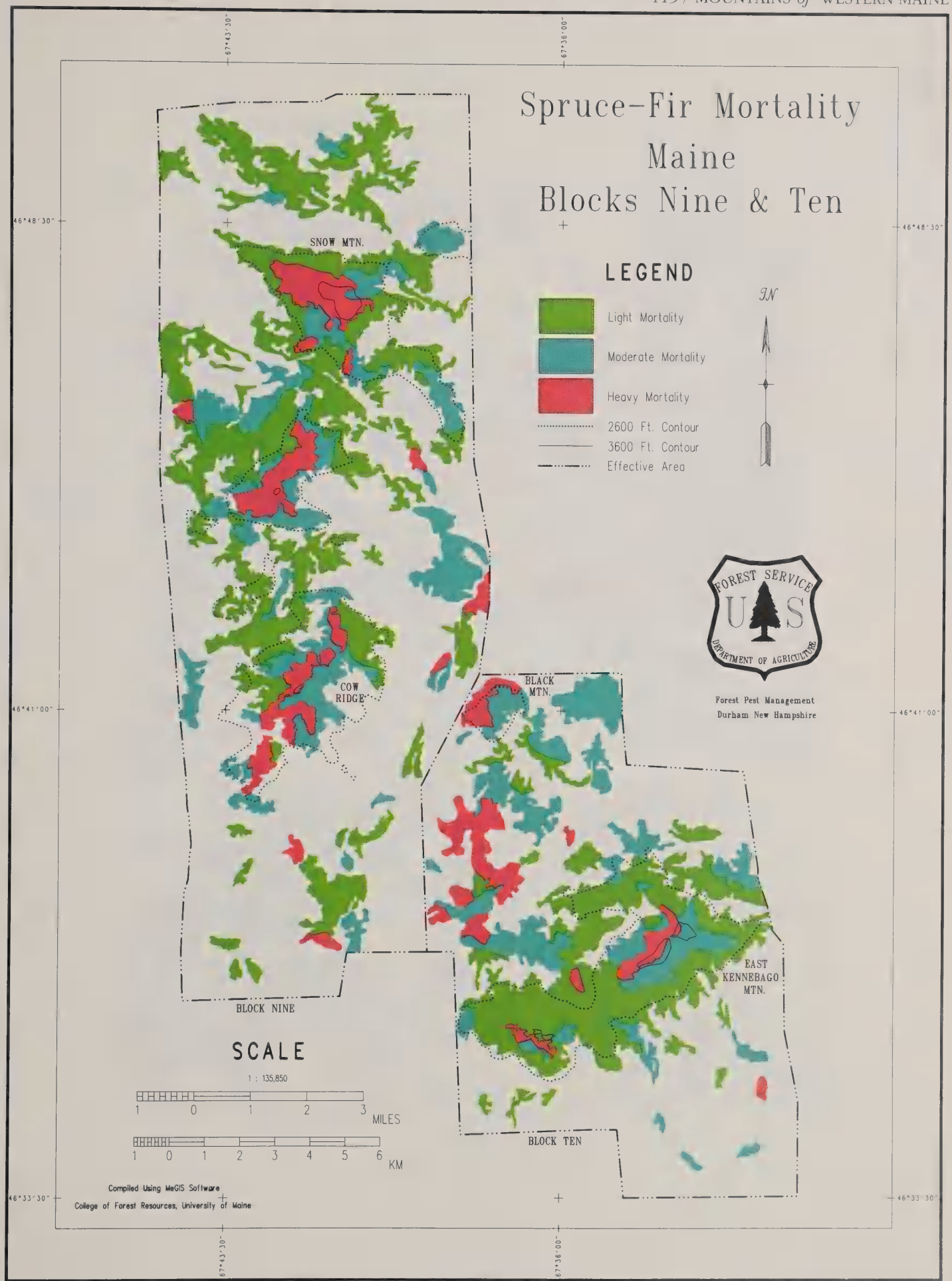

Spruce-Fir Mortality
Maine
Blocks Nine & Ten
LEGEND
Light Mortality
Moderate Mortality
Heavy Mortality
2600 Ft. Contour
3600 Ft. Contour
Effective Area
N
SNOW MTN.
COW RIDGE
BLACK MTN.
EAST KENNEBAGO MTN.
BLOCK NINE
BLOCK TEN
FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE
Forest Pest Management
Durham New Hampshire
SCALE
1 : 135,850
1 0 1 2 3 MILES
1 0 1 2 3 4 5 6 KM
Compiled Using MeGIS Software
College of Forest Resources, University of Maine
67°43'30"
67°36'00"
46°48'30"
46°41'00"
46°33'30"

FIGURE ME22.

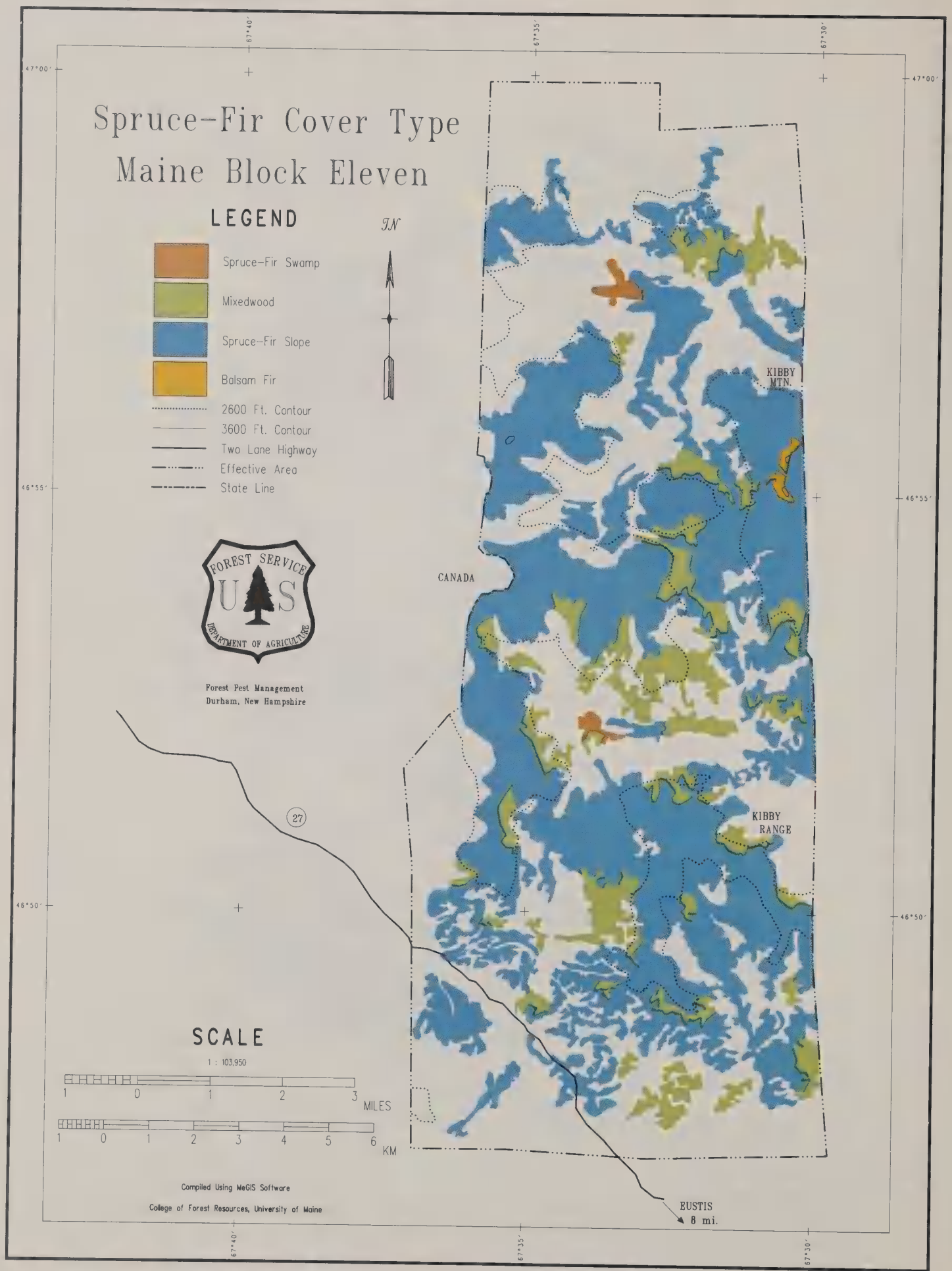

Spruce-Fir Cover Type
Maine Block Eleven
LEGEND
Spruce-Fir Swamp
Mixedwood
Spruce-Fir Slope
Balsam Fir
2600 Ft. Contour
3600 Ft. Contour
Two Lane Highway
Effective Area
State Line
IN
FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE
Forest Pest Management
Durham, New Hampshire
CANADA
KIBBY MTN.
KIBBY RANGE
27
EUSTIS
8 mi.
SCALE
1 : 103,950
1 0 1 2 3 MILES
1 0 1 2 3 4 5 6 KM
Compiled Using MeGIS Software
College of Forest Resources, University of Maine
67°40'
67°35'
67°30'
47°00'
46°55'
46°50'

FIGURE ME23.

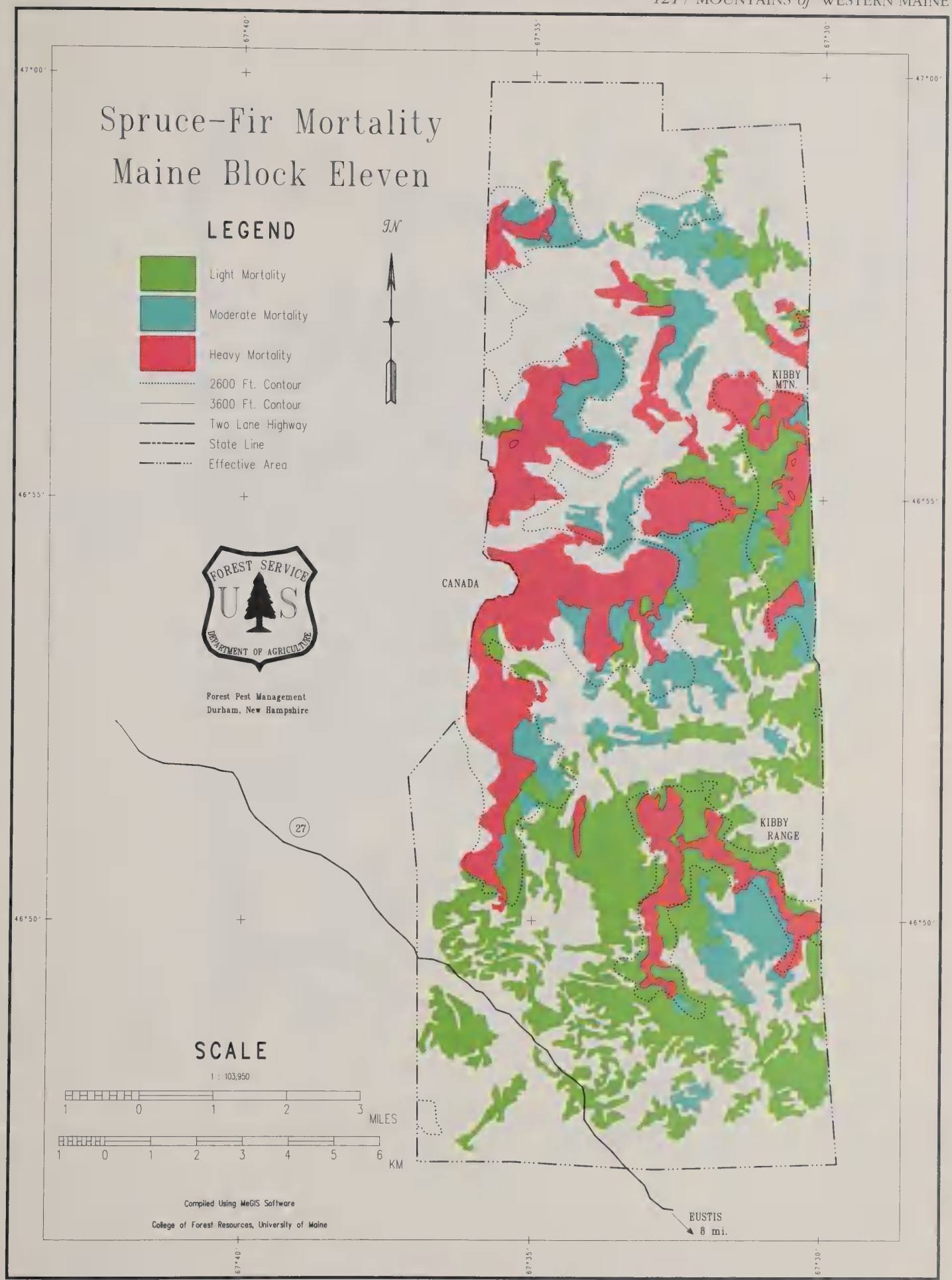

Spruce-Fir Mortality
Maine Block Eleven
LEGEND
Light Mortality
Moderate Mortality
Heavy Mortality
2600 Ft. Contour
3600 Ft. Contour
Two Lane Highway
State Line
Effective Area
N
FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE
Forest Pest Management
Durham, New Hampshire
CANADA
KIBBY MTN.
KIBBY RANGE
27
EUSTIS
8 mi.
SCALE
1 : 103,950
1 0 1 2 3 MILES
1 0 1 2 3 4 5 6 KM
Compiled Using MeGIS Software
College of Forest Resources, University of Maine
47°00'
46°55'
46°50'
67°40'
67°35'
67°30'

FIGURE ME24.

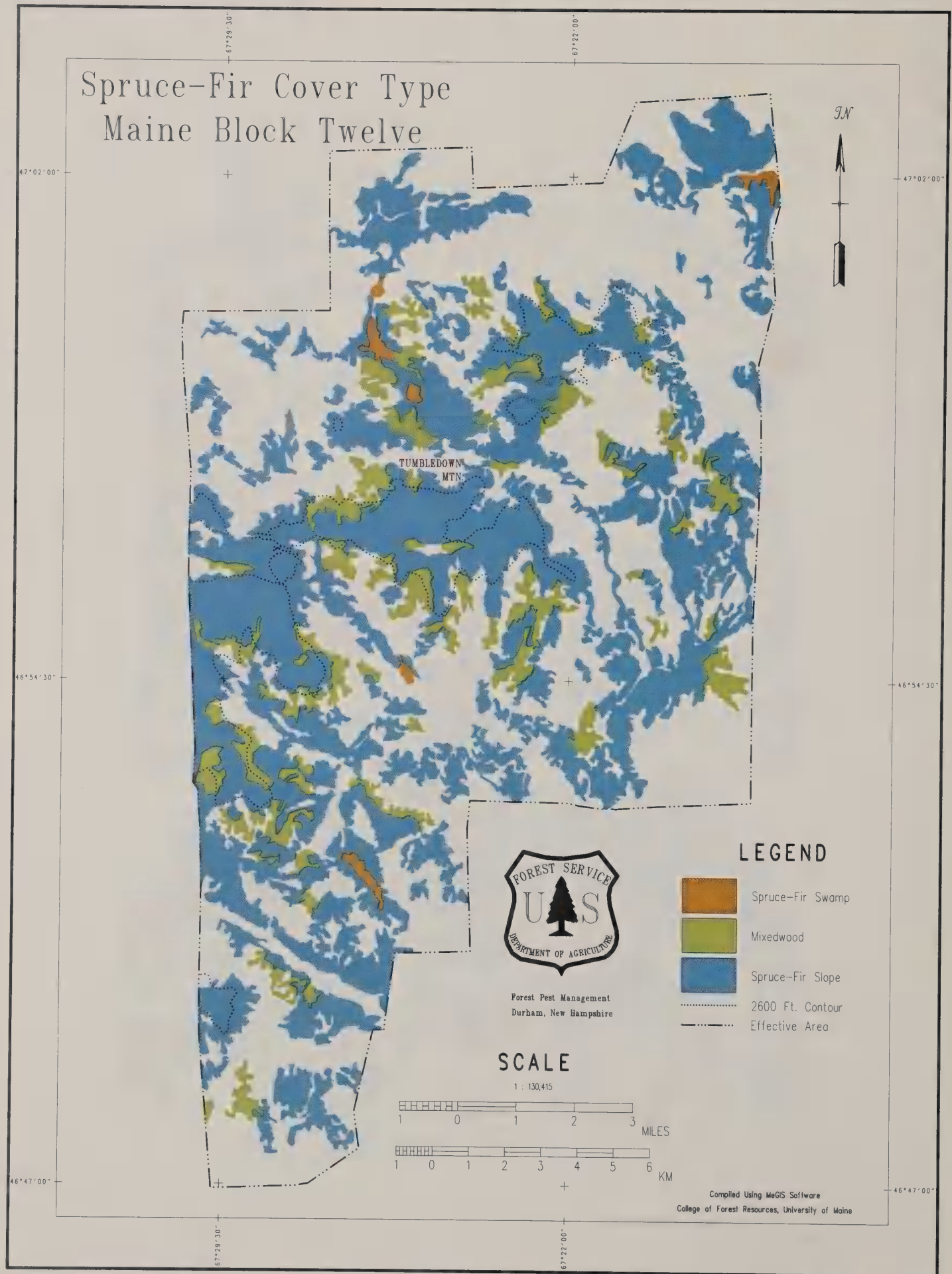

Spruce-Fir Cover Type
Maine Block Twelve
67°29'30"
67°22'00"
47°02'00"
46°54'30"
46°47'00"
TUMBLEDOWN MTN.
N
FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE
Forest Pest Management
Durham, New Hampshire
LEGEND
Spruce-Fir Swamp
Mixedwood
Spruce-Fir Slope
2600 Ft. Contour
Effective Area
SCALE
1 : 130,415
1 0 1 2 3 MILES
1 0 1 2 3 4 5 6 KM
Compiled Using MeGIS Software
College of Forest Resources, University of Maine

FIGURE ME25.

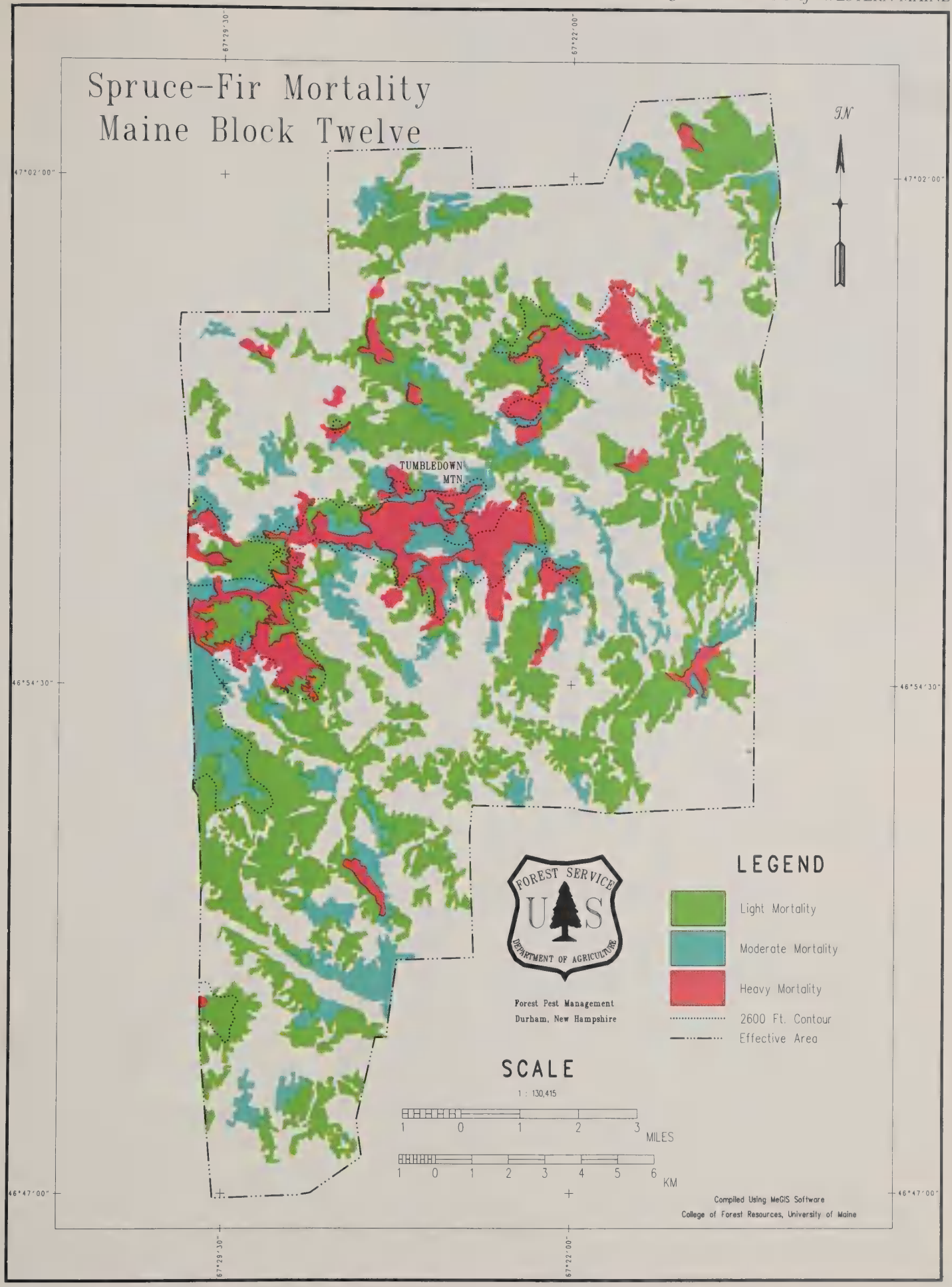

Spruce-Fir Mortality
Maine Block Twelve
67°29'30"
67°22'00"
47°02'00"
46°54'30"
46°47'00"
TUMBLEDOWN MTN.
FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE
Forest Pest Management
Durham, New Hampshire
LEGEND
Light Mortality
Moderate Mortality
Heavy Mortality
2600 Ft. Contour
Effective Area
SCALE
1 : 130,415
1 0 1 2 3 MILES
1 0 1 2 3 4 5 6 KM
Compiled Using MeGIS Software
College of Forest Resources, University of Maine

FIGURE ME26.

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APPENDIX A

Cover Type & Mortality Tables

Area of spruce-fir cover type and mortality (standing dead) class by elevation and by mapping unit for:

ADIRONDACK REGION *of* NEW YORK
TABLES A.1-A.2

GREEN MOUNTAINS *of* VERMONT
TABLES A.3-A.4

WHITE MOUNTAINS *of* NEW HAMPSHIRE
TABLES A.5-A.6

MOUNTAINS *of* WESTERN MAINE
TABLES A.7-A.8

TABLE A.1.

Area of spruce-fir cover type and mortality (standing dead) class by elevation in the Adirondack Region of New York (based on 1985 and 1986 aerial photography).

COVER TYPE & MORTALITY CLASS	ELEVATION <2600 FT	2600-3600 FT	3600-4600 FT	>4600 FT	TOTAL
			ACRES		
SPRUCE-FIR SWAMP:					
Light	14,434	142	0	0	14,576
Moderate	9,324	24	0	0	9,348
Heavy	1,701	0	0	0	1,701
Cover type total	25,459	166	0	0	25,625
MIXEDWOOD:					
Light	12,842	4,975	189	0	18,006
Moderate	19,801	12,717	1,401	0	33,919
Heavy	20,124	12,739	1,002	7	33,872
Cover type total	52,767	30,431	2,592	7	85,797
SPRUCE-FIR SLOPE:					
Light	15,636	7,858	934	3	24,431
Moderate	13,295	12,490	3,039	32	28,856
Heavy	9,262	30,318	9,938	65	49,583
Cover type total	38,193	50,666	13,911	100	102,870
BALSAM FIR:					
Light	0	0	104	31	135
Moderate	0	350	1,073	73	1,496
Heavy	0	764	2,954	133	3,851
Cover type total	0	1,114	4,131	237	5,482
TOTAL	**116,419**	**82,377**	**20,634**	**344**	**219,774**
Land area photographed	959,320	170,438	24,395	883	1,155,036

TABLE A.2.

Area of spruce-fir cover type and mortality (standing dead) class in each of the mapping units in the Adirondack Region of New York (based on 1985 and 1986 aerial photography).

COVER TYPE & MORTALITY CLASS	UNIT NUMBER						
	ONE	TWO	THREE	FOUR	FIVE	SIX	SEVEN
	ACRES						
SPRUCE-FIR SWAMP:							
Light	35	954	1,548	2,933	1,881	0	805
Moderate	106	913	1,575	1,494	833	0	335
Heavy	0	0	170	26	91	0	366
MIXEDWOOD:							
Light	272	79	2,134	5,419	1,833	631	157
Moderate	432	55	3,558	7,984	3,957	780	153
Heavy	123	0	2,223	8,651	5,950	360	21
SPRUCE-FIR SLOPE:							
Light	147	83	3,362	5,642	3,681	990	346
Moderate	821	0	3,501	5,716	5,926	1,357	258
Heavy	476	97	7,831	10,192	17,839	959	43
BALSAM FIR:							
Light	0	0	0	0	111	25	0
Moderate	0	0	209	439	598	57	0
Heavy	37	0	1,005	903	1,709	52	0
TOTAL	**2,449**	**2,181**	**27,116**	**49,399**	**44,409**	**5,211**	**2,484**

TABLE A.2. CONTINUED

COVER TYPE & MORTALITY CLASS	UNIT NUMBER						
	EIGHT	NINE	TEN	ELEVEN	TWELVE	THIRTEEN	FOURTEEN
	ACRES						
SPRUCE-FIR SWAMP:							
Light	1,865	920	189	2,346	482	437	180
Moderate	161	1,177	188	1,302	826	392	45
Heavy	70	230	0	293	0	120	334
MIXEDWOOD:							
Light	862	2,262	1,377	967	595	342	1,076
Moderate	1,060	3,594	2,030	1,703	3,854	1,067	3,694
Heavy	1,180	4,334	2,236	1,168	1,412	2,105	4,109
SPRUCE-FIR SLOPE:							
Light	2,220	2,000	1,532	640	1,850	378	1,560
Moderate	908	3,269	1,527	1,248	1,735	423	2,167
Heavy	480	3,346	5,422	469	694	75	1,662
BALSAM FIR:							
Light	0	0	0	0	0	0	0
Moderate	0	0	193	0	0	0	0
Heavy	0	0	143	0	0	0	0
TOTAL	**8,806**	**21,132**	**14,837**	**10,136**	**11,448**	**5,339**	**14,827**

TABLE A.3.

Area of spruce-fir cover type and mortality (standing dead) class by elevation in the Green Mountains of Vermont (based on 1985 aerial photography).

COVER TYPE & MORTALITY CLASS	ELEVATION				
	<2600 FT	2600-3600 FT	3600-4600 FT	>4600 FT	TOTAL
	ACRES				
SPRUCE-FIR SWAMP:					
Light	685	191	0	0	876
Moderate	149	154	0	0	303
Heavy	31	0	0	0	31
Cover type total	865	345	0	0	1,210
MIXEDWOOD:					
Light	13,021	5,067	306	0	18,394
Moderate	2,056	4,400	208	0	6,664
Heavy	594	2,824	236	0	3,654
Cover type total	15,671	12,291	750	0	28,712
SPRUCE-FIR SLOPE:					
Light	9,325	2,477	258	0	12,060
Moderate	1,338	3,885	809	0	6,032
Heavy	200	1,637	377	0	2,214
Cover type total	10,863	7,999	1,444	0	20,306
BALSAM FIR:					
Light	258	14	0	0	272
Moderate	71	419	160	0	650
Heavy	17	323	205	0	545
Cover type total	346	756	365	0	1,467
TOTAL	**27,745**	**21,391**	**2,559**	**0**	**51,695**
Land area photographed	1,297,020	110,167	3,148	0	1,410,335

TABLE A.4.

Area of spruce-fir cover type and mortality (standing dead) class in each of the mapping units in the Green Mountains of Vermont (based on 1985 aerial photography).

COVER TYPE & MORTALITY CLASS	UNIT NUMBER ONE	TWO	THREE	FOUR	FIVE
			ACRES		
SPRUCE-FIR SWAMP:					
Light	72	615	0	77	112
Moderate	0	303	0	0	0
Heavy	0	31	0	0	0
MIXEDWOOD:					
Light	6,649	9,413	1,428	792	112
Moderate	1,494	1,744	2,448	240	738
Heavy	1,468	414	1,145	200	427
SPRUCE-FIR SLOPE:					
Light	3,529	6,678	631	1,171	51
Moderate	1,358	1,971	1,476	220	1,007
Heavy	841	347	963	63	0
BALSAM FIR:					
Light	108	53	0	111	0
Moderate	57	107	293	131	62
Heavy	269	0	184	48	44
TOTAL	**15,845**	**21,676**	**8,568**	**3,053**	**2,553**

TABLE A.5.

Area of spruce-fir cover type and mortality (standing dead) class by elevation in the White Mountains of New Hampshire (based on 1985 and 1986 aerial photography).

COVER TYPE & MORTALITY CLASS	ELEVATION <2600 FT	2600-3600 FT	3600-4600 FT	>4600 FT	TOTAL
			ACRES		
SPRUCE-FIR SWAMP:					
Light	1,249	51	0	0	1,300
Moderate	672	0	0	0	672
Heavy	385	18	0	0	403
Cover type total	2,306	69	0	0	2,375
MIXEDWOOD:					
Light	21,681	9,689	793	0	32,163
Moderate	5,793	10,328	1,137	0	17,258
Heavy	2,329	4,966	749	0	8,044
Cover type total	29,803	24,983	2,679	0	57,465
SPRUCE-FIR SLOPE:					
Light	37,812	15,202	5,531	94	58,639
Moderate	12,104	19,323	6,087	63	37,577
Heavy	5,225	20,707	9,508	159	35,599
Cover type total	55,141	55,232	21,126	316	131,815
BALSAM FIR:					
Light	0	36	276	128	440
Moderate	8	225	1,868	570	2,671
Heavy	0	533	3,809	276	4,618
Cover type total	8	794	5,953	974	7,729
TOTAL	**87,258**	**81,078**	**29,758**	**1,290**	**199,384**
Land area photographed	1,164,829	177,591	34,993	6,426	1,383,839

TABLE A.6.

Area of spruce-fir cover type and mortality (standing dead) class in each of the mapping units in the White Mountains of New Hampshire (based on 1985 and 1986 aerial photography).

COVER TYPE & MORTALITY CLASS	UNIT NUMBER ONE	TWO	THREE	FOUR	FIVE	SIX
			ACRES			
SPRUCE-FIR SWAMP:						
Light	270	212	273	25	168	298
Moderate	88	0	0	66	28	0
Heavy	0	0	0	0	0	91
MIXEDWOOD:						
Light	5,312	4,231	2,365	6,145	3,790	6,932
Moderate	2,918	1,749	4,048	3,626	2,893	1,852
Heavy	223	377	2,717	3,097	1,160	470
SPRUCE-FIR SLOPE:						
Light	4,393	8,728	7,824	13,275	9,066	7,422
Moderate	3,667	6,002	4,580	10,202	7,714	3,918
Heavy	2,745	1,762	9,383	11,656	6,288	2,816
BALSAM FIR:						
Light	28	89	262	0	0	61
Moderate	0	0	1,720	340	83	528
Heavy	221	1,006	1,194	1,605	61	531
TOTAL	**19,865**	**24,156**	**34,366**	**50,037**	**31,251**	**24,919**

TABLE A.7.

Area of spruce-fir cover type and mortality (standing dead) class by elevation in the mountains of western Maine (based on 1986 aerial photography).

COVER TYPE & MORTALITY CLASS	ELEVATION <2600 FT	2600-3600 FT	3600-4600 FT	>4600 FT	TOTAL
			ACRES		
SPRUCE-FIR SWAMP:					
Light	1,515	0	0	0	1,515
Moderate	2,220	0	0	0	2,220
Heavy	2,172	155	0	0	2,327
Cover type total	5,907	155	0	0	6,062
MIXEDWOOD:					
Light	32,845	6,997	0	0	39,842
Moderate	6,485	1,514	0	0	7,999
Heavy	2,036	324	0	0	2,360
Cover type total	41,366	8,835	0	0	50,201
SPRUCE-FIR SLOPE:					
Light	70,284	24,084	427	0	94,795
Moderate	23,632	22,029	749	0	46,410
Heavy	12,886	29,810	1,414	0	44,110
Cover type total	106,802	75,923	2,590	0	185,315
BALSAM FIR:					
Light	0	294	58	0	352
Moderate	0	271	83	0	354
Heavy	0	414	344	0	758
Cover type total	0	979	485	0	1,464
TOTAL	**154,075**	**85,892**	**3,075**	**0**	**243,042**
Land area photographed	551,523	108,597	3,730	0	663,850

TABLE A.8.

Area of spruce-fir cover type and mortality (standing dead) class in each of the mapping units in the mountains of western Maine (based on 1986 aerial photography).

COVER TYPE & MORTALITY CLASS	PHOTO BLOCK NUMBER					
	ONE/NH	ONE/ME	TWO	THREE	FOUR	FIVE & SIX
	ACRES					
SPRUCE-FIR SWAMP:						
Light	327	176	63	0	184	166
Moderate	217	65	0	0	866	408
Heavy	311	45	182	0	731	362
MIXEDWOOD:						
Light	3,388	4,753	2,552	302	7,521	6,589
Moderate	172	258	705	0	511	828
Heavy	0	0	399	0	231	316
SPRUCE-FIR SLOPE:						
Light	7,930	13,170	10,258	787	14,319	10,554
Moderate	1,495	4,566	2,364	876	8,184	4,633
Heavy	949	4,399	6,839	144	4,317	4,546
BALSAM FIR:						
Light	0	0	0	0	176	175
Moderate	0	32	0	0	235	65
Heavy	0	0	227	0	454	0
TOTAL	**14,789**	**27,464**	**23,589**	**2,109**	**37,729**	**28,642**

TABLE A.8. CONTINUED

COVER TYPE AND MORTALITY CLASS	PHOTO BLOCK NUMBER SEVEN	EIGHT	NINE & TEN	ELEVEN	TWELVE
			ACRES		
SPRUCE-FIR SWAMP:					
Light	0	137	791	0	0
Moderate	0	0	680	65	137
Heavy	180	65	343	110	309
MIXEDWOOD:					
Light	1,379	2,210	6,669	2,644	5,222
Moderate	349	430	3,010	1,216	691
Heavy	236	96	765	0	317
SPRUCE-FIR SLOPE:					
Light	7,043	3,128	8,639	7,988	18,517
Moderate	3,489	6,879	5,722	3,277	6,813
Heavy	3,215	6,174	2,883	6,627	4,964
BALSAM FIR:					
Light	0	0	0	0	0
Moderate	0	20	0	0	0
Heavy	0	0	0	77	0
TOTAL	**15,891**	**19,139**	**29,502**	**22,004**	**36,970**